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BROOKLYN EAGLE
GOVERNMENT COOK BOOK

FISH, EGGS AND FRUIT

PRINCIPLES OF NUTRITION
And Nutritive Value of Foods

BY

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FISH AS FOOD
EGGS AND THEIR USE
FRUIT IN DIET

BY

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CANNED FRUIT, PRESERVES AND JELLIES

BY

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Prepared Under the Direction of the U. S. Department of Agriculture.

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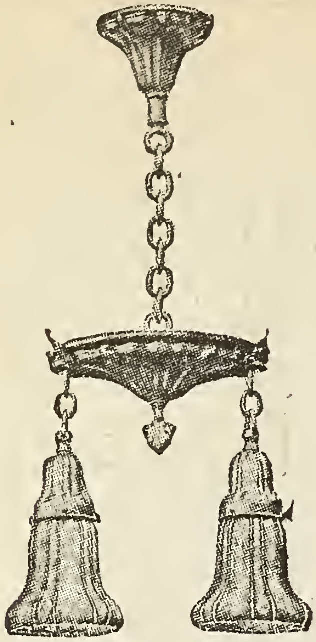

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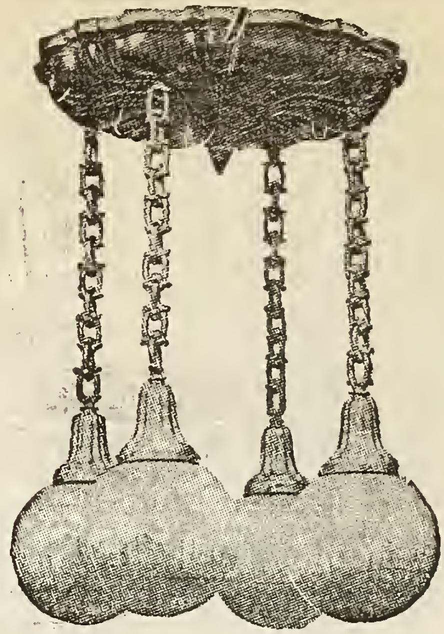

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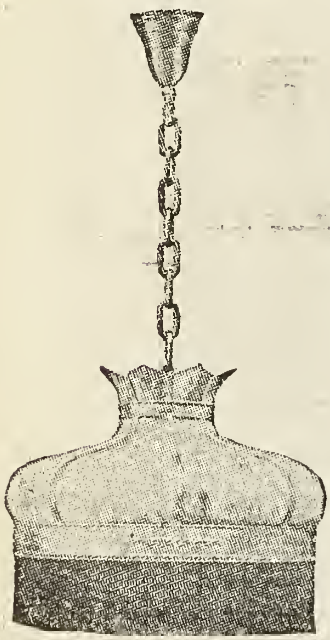

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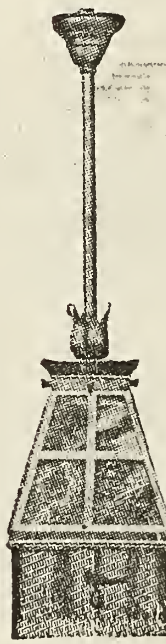

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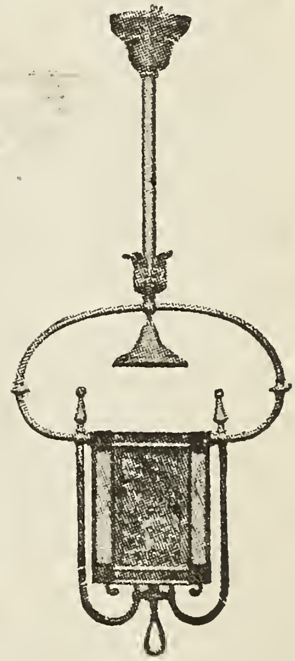

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Principles of Nutrition

—AND—

Nutritive Value of Food

INTRODUCTION.

The problem of proper nutrition has always been of great importance, yet scientific study of this subject is comparatively recent. Food investigations have been carried on in Europe for some three-quarters of a century, and for a less time in the United States. In recent years the development of this subject has been very rapid; a large number of investigations have been carried on under the auspices of this Department, the agricultural stations, and various educational institutions, and many facts of interest and importance have been learned. It seems desirable, therefore, to summarize this information, and, so far as possible, to interpret the results in such a way as to show their practical application.

Constant use has made us so familiar with our ordinary foods that we seldom realize how complicated they are; yet a thorough understanding of them takes us far, not only into chemistry, but into physics and physiology as well.

CHEMICAL COMPOSITION OF THE BODY AND OF FOOD.

The chemical substances of which the body is composed are very similar to those of the foods which nourish it. They are made up of the same chemical elements, and hence the two may be discussed together. From fifteen to twenty elements are found, among the most abundant of which are oxygen, hydrogen, carbon, nitrogen, calcium, phosphorus and sulphur. The elements are so combined as to form a great variety of compounds in both body and food. The most important kinds of compounds in the body and in foods are protein, fats, carbohydrates, mineral matter and water. The functions of these compounds in the food, as explained in detail in this bulletin, are to build and repair the various tissues of the body and to supply it with heat and muscular energy.

WATER.

Water is one of the most abundant of these compounds. It forms over 60 per cent. of the weight of the body of the average man, being a component part of all the tissues. It is thus an important constituent of our food, though it cannot be burned, and hence does not yield energy to the body.

MINERAL MATTER OR ASH.

Other food ingredients which yield little or no energy and are yet indispensable to the body are the mineral matters. They form only 5 or 6 per cent. of the body by weight, and are found chiefly in the bones and teeth, but are present also in the other tissues and in solution in the various fluids. When food or body material is burned the mineral constituents remain as ash. Phosphate of lime, or calcium phosphate, is the mineral basis of bone. Numerous compounds of potassium, sodium, magnesium and iron are found in the body and are necessary to life.

The remaining nutritive materials are organic compounds, so called because they occur principally in the organic, i. e., the animal and vegetable world. They all contain carbon, oxygen and hydrogen, in varying proportions. Some also contain nitrogen, phosphorus, sulphur, or other elements. Those occurring in the body and in food are divided into three principal groups—protein, fats and carbohydrates.

PROTEIN.

This term includes the principal nitrogenous compounds. Protein is familiar to us in the lean and gristle of meat, the white of eggs, the gluten of wheat, etc. It forms about 18 per cent., by weight, of the body of the average man. Protein compounds may be subdivided into albuminoids, gelatinoids and extractives. The first group, the albuminoids, include substances similar to the white of egg, the lean of meat (myosin), the curd of milk (casein), and the gluten of wheat. The second group, the gelatinoids, occur principally in the connective tissues, such as the collagen of the tendons and skin and the ossein of bone.

The albuminoids and gelatinoids, classed together as proteids, are most important constituents of our food. They make the basis of bone, muscle, and other tissues, and are essential to the body structure. They are also used as fuel—that is, they are burned in the body to yield energy—and they are to some extent transformed into fat and stored in the body, but these are their less important uses. The protein compounds are most abundant in some of the animal foods, as lean meat, though the cereals contain them in considerable, and peas and beans in large, proportions. The gelatinoids are less valuable than the albuminoids for nutriment.

The third class, the so-called extractives, are included with the protein compounds because they contain nitrogen, but they differ greatly from the albuminoids and gelatinoids. They are the principal ingredients of meat extracts, beef tea, etc. They are believed to neither build tissue nor furnish energy, but to act as stimulants and appetizers. The craving which

some persons have for meat is perhaps due in part to a desire for these extractives. The nitrogenous compounds of potatoes and other vegetable foods contain more or less of so-called amids, like asparagin, which are analogous to the extractives of meat, and like them cannot build tissue, and hence have an inferior nutritive value.

FATS.

Fats occur chiefly in animal foods, as meats, fish, butter, etc. They are also abundant in some vegetable products, such as olives and cotton seed, from which they are expressed as oil, and occur in considerable quantities in some cereals, notably oatmeal and maize (whole kernel), and in various nuts. In our bodies and those of animals fats occur in masses under the skin and in other localities, and in minute particles scattered through the various tissues. The amount of fat in the body varies greatly with food, exercise, age, and other conditions. When more food is taken than is necessary for immediate use part of the surplus may be stored in the body. The protein and fat of food may thus become body protein and body fat; sugar and starch of food are changed to fat in the body and stored as such. When the food supply is short this reserve material is drawn upon for supplementary fuel. Fat forms about 15 per cent., by weight, of the body of an average man. Well-fed or over-fed people with little muscular exercise often grow fat, but the tendency to fatness or leanness is more or less a question of personal idiosyncrasy or some other little understood factor, and not decided by food and exercise alone.

CARBOHYDRATES.

These include such compounds as starches, different kinds of sugar, and the fiber of plants or cellulose. They are found chiefly in the vegetable foods, like cereal grains and potatoes; milk, however, contains considerable amounts of milk sugar, which is a carbohydrate. The carbohydrates form only a very small proportion of the body tissues—less than 1 per cent. Starches and sugars, which are very abundant in ordinary food materials, are important food ingredients, because they form an abundant source of energy and are easily digested. They may be and often are transformed into fat in the body.

REFUSE.

Food, as we buy it at the market or even as it is served on the table, contains more or less of materials which we cannot or do not eat, and which would have little or no nutritive value if we did eat them; such, for instance, as the bones of meat and fish, the shells of eggs and the skins and seeds of fruits and vegetables. In discussing the chemical composition of foods such portions are usually counted as refuse, but they make an important item when we consider the actual cost of the nutrients of food. The materials grouped together as refuse contain, in part, the same ingredients as the edible portion, though usually in very different proportions. The bones are largely mineral matter, with some fat and protein; eggshells are almost entirely mineral matter; bran of wheat has a high content of fiber or woody material. Generally speaking, vegetable refuse is characterized by a high content of these latter constituents. In some cases material which is edible is classed as refuse because the flavor is objectionable. Thus peach and plum pits are too highly flavored to be agreeable if eaten in quantity, and are commonly thought to be actually injurious.

FOOD AS BUILDING MATERIAL AND FUEL. THE BODY AS A MACHNIE.

Blood and muscle, bone and tendon, brain and nerve—all the organs and tissues of the body—are built from the nutritive ingredients of food. With every motion of the body and with the exercise of feeling and thought as well, material is consumed and must be resupplied by food. In a sense, the body is a superior machine. Like other machines, it requires material to build up its several parts, to repair them as they are worn out, and to serve as fuel. In some ways it uses this material like a machine; in others it does not. The steam engine gets its power from fuel; the body does the same. In the one case coal or wood, in the other food, is the fuel. In both cases the energy which is latent in the fuel—the potential energy, as it is called in scientific language—is transformed into power and heat.

From the time foods are taken into the body until they are digested, absorbed, utilized, and finally converted largely into the carbon dioxide and water vapor of the breath and the nitrogenous and other excretory products of the urine and feces, they undergo great chemical changes, very many of which liberate heat as a result of oxidation or some closely related process. It is through these complex chemical processes that the body derives the energy for internal and external muscular work. Heat is evolved by such chemical changes and also results from the muscular work of the body, and there is reason to be believe that within wide limits the heat thus produced is sufficient for maintaining body temperature. The amount of heat produced in the body must, of course, vary with the amount of food eaten, the work done, and other circumstances. However, the body is such a perfect piece of mechanism that the loss of heat by radiation, etc., is so adjusted to heat production that body temperature remains fairly constant.

One important difference between the human machine and the steam engine is that the former is self-building, self-repairing, and self-regulating. Another is that the material of which the engine is built is very different from that which it uses for fuel, but part of the material which serves the body as a source of energy also builds it up and keeps it in repair. Furthermore, the body can use its own substance for this purpose. This the steam engine cannot do. The steam engine and the body are alike in that both convert the fuel into mechanical power and heat. They differ in that the body uses the same material for fuel as for building and also consumes its own material for fuel. In the use of its source of power the body is much more economical than any engine.

But the body is more than a machine. It has not simply organs to build and keep in repair and supply with energy; it has a nervous organization; it has sensibilities; and there are the higher intellectual and spiritual faculties. The right exercise of these depends upon the right nutrition of the body.

The chief uses of food, then, are two: (1) To form the material of the body and repair its wastes, and (2) to furnish muscular and other power for the work the body has to do and yield heat to keep the body warm. In forming the tissues and the fluids of the body the food serves for building and repair. In yielding power and heat it serves as fuel.

If more food is eaten than is needed, more or less of the surplus may be and sometimes is stored in the body, chiefly in the form of fat. The fat in the body forms a sort of reserve supply of fuel and is utilized in the place of food. When the work is hard or the food supply

is low the body draws upon this store of fat and grows lean.

PROTEIN AS BUILDING MATERIAL.

The principal tissue formers are the protein compounds, especially the albuminoids. These make the framework of the body. They build up and repair the nitrogeneous materials, as the muscles and tendons, and supply the albuminoids of the blood, milk and other fluids.

The albuminoids of food are transformed into the albuminoids and gelatinoids of the body. Muscle, tendon and cartilage, bone and skin, the corpuscles of the blood, and the casein of milk are made of the albuminoids of food. The albuminoids are sometimes called "flesh formers" or "muscle formers," because the lean flesh, the muscle, is made from them, though the term is inadequate, as it leaves out of account the energy-furnishing function of protein. The gelatinoids of food, such as the finer particles of tendon and the gelatin, which are dissolved out of bone and meat in soup, though somewhat similar to the albuminoids in composition, are not believed to be tissue formers; but they are valuable in protecting the albuminoids from consumption. That is, when the food contains gelatinoids in abundance less of albuminoids is used.

The proteids can be so changed in the body as to yield fats and carbohydrates, and such changes actually occur to some extent. In this and other ways they supply the body with fuel.

PROTEIN AS FUEL FOR THE BODY.

The protein compounds are not only used for building and repairing tissue, but are also burned directly in the body like the carbohydrates, and thus render important service as fuel. A dog can live on lean meat. He can convert its material into muscle and its energy into heat and muscular power. Man can do the same; but such a one-sided diet would not be best for the dog and it would be still worse for man. The natural food for carniverous animals, like the dog, supplies fats and some carbohydrates, and that for omnivorous animals, like man, furnishes fats and carbohydrates in liberal amounts along with protein. Herbivorous animals, like horses, cattle and sheep, naturally require large proportions of carbohydrates.

FATS AND CARBOHYDRATES AS FUEL.

Fats and carbohydrates are the chief fuel ingredients of food. Sugar and the starch of bread and potatoes are burned in the body to yield heat and power. The fats, such as the fat of meat and butter, serve the same purpose, only they are a more concentrated fuel than the carbohydrates.

The body can also transform carbohydrates of food into fat. This fat, and with it that stored from the food, is kept in the body as reserve fuel in the most concentrated form.

The different nutrients can to a greater or less extent do one another's work. If the body has not enough of one kind of fuel it can use another. But, while protein can be burned in the place of fats and carbohydrates, neither of the latter can take the place of the albuminoids in building and repairing the tissues. At the same time the gelatinoids, fats and carbohydrates, by being consumed themselves, protect the albuminoids from consumption.

VALUE OF FOOD FOR SUPPLYING ENERGY.

Heat and muscular power are forms of force or energy. The energy latent in the food is developed as the food is consumed in the body. The process is more or less akin to that which takes place when coal is burned in the furnace of the locomotive. For the burning of the food in the body or the coal in the furnace, air is used to supply oxygen. When the fuel is oxidized, be it meat or wood, bread or coal, the latent energy becomes active, or, in technical language, the potential energy becomes kinetic; it is transformed into power and heat. As various kinds of coal differ in the amount of heat given off per ton, so various kinds of food and food ingredients give off different amounts of energy; that is, have different values as fuel in the body.

HEAT OF COMBUSTION.

The processes of oxidation of material and transformation of energy in the body are less simple than in the engine and less clearly understood. Later research, however, has given us ways of measuring the energy latent in coal, wood, and in food materials as well. This is most generally done in the chemical laboratory by an apparatus called the bomb calorimeter. The amount of heat given off in the oxidation of a given quantity of any material is called its "heat of combustion," and is taken as a measure of its latent or potential energy. The unit commonly used is the calorie, the amount of heat which would raise the temperature of 1 kilogram of water 1° C., or, what is nearly the same thing, 1 pound of water 4° F. Instead of this unit of heat a unit of mechanical energy may be used—for instance, the foot-ton, which represents the force required to raise 1 ton 1 foot. One calorie is equal to very nearly 1.54 foot-tons; that is to say, 1 calorie of heat, when transformed into mechanical power, would suffice to lift 1 ton 1.54 feet.

THE CONSERVATION OF ENERGY IN THE BODY.

The amounts of energy transformed in the body when food and its own material are burned within it are measured with the respiration calorimeter. It is well known that the food is not completely oxidized in the body. These experiments have shown that the material which is oxidized yields the same amount of energy as it would if burned with oxygen outside the body, e. g., in the bomb calorimeter. The experiments show also that when a man does no muscular work (save, of course, the internal work of respiration, circulation, etc.), all the energy leaves his body as heat; but when he does muscular work, as in lifting weights or driving a bicycle, part of the energy appears in the external work thus done, and the rest is given off from the body as heat. The most interesting result of all is that the energy given off from the body as heat when the man is at rest, or as heat and mechanical work together when he is working, exactly equals the latent energy of the material burned in the body. This is in accordance with the law of the conservation of energy. It thus appears that the body actually obeys, as we should expect it to obey, this great law which dominates the physical universe.

FUEL VALUE.

We may make practical application of this principle of the conservation of energy in the body in measuring the actual value of food as fuel to the body, i. e., its "fuel value," by use of the bomb and respiration calorimeters. To do this we have to take into account the chemical composition of the food, the proportions of the nutrients actually digested and oxidized in the body, and the proportion of the whole latent energy of each which becomes active and useful to the body for warmth and work. Taking our common food materials as they are used in ordinary diet, the following general estimate

has been made for the energy furnished to the body by 1 gram or 1 pound of each of the classes of nutrients:

Protein, fuel value, 4 calories per gram, or 1,820 calories per pound.

Fats, fuel value, 9 calories per gram, or 4,040 calories per pound.

Carbohydrates, fuel value, 4 calories per gram, or 1,820 calories per pound.

It will be seen that when we compare the nutrients in respect to their fuel value, their capacities for yielding heat and mechanical power, a pound of protein of lean meat or albumen of egg is just about equivalent to a pound of sugar or starch, and a little over 2 pounds of either would be required to equal a pound of the fat of meat or butter or of body fat.

The fuel value of food obviously depends upon the amounts of actual nutrients, and especially upon the amount of fat it contains. Thus a pound of wheat flour, which consists largely of starch, has an average fuel value of about 1,625 calories, and a pound of butter, which is mostly fat, about 3,410 calories. These are only about one-eighth water. Whole milk, which is seven-eighths water, has an average fuel value of 310 calories per pound; cream, which has more fat and less water, 865 calories, and skim milk, which is whole milk after the cream has been removed, 165 calories.

This high fuel value of fat explains the economy of nature in storing fat in the body for use in case of need. Fat is the most concentrated form of body fuel.

We have been considering food as a source of heat and muscular power. There is no doubt that intellectual activity, also, is somehow dependent upon the consumption of material which the brain has obtained from the food; but just what substances are consumed to produce brain and nerve force, and how much of each is required for a given quantity of intellectual labor, are questions which the physiological chemist has not yet answered.

HOW THE FUNCTIONS AND NUTRITIVE VALUE OF FOOD ARE LEARNED.

The principles above explained are based upon a great deal of experimenting and observation. The experimenting is of many kinds, but of especial importance is the work with the respiration apparatus and respiration calorimeter.

Various forms of respiration apparatus have been devised within the last fifty years. Among the most important are those invented by Pettenkofer and Voit in Munich. They consist of metal-walled chambers large enough for the subject (sometimes a man, sometimes a dog, sheep, or other animal) to live in comfortably for several days, and are furnished with devices for pumping air through and measuring and analyzing it as it enters and leaves the chamber. With such an apparatus it is possible not only to measure all the food and excreta, but also the materials given off from the lungs in the breath, and to make accurate determination of the matter entering and leaving the body.

A still more elaborate apparatus, by which not only all the matter passing in and out of the body may be measured, but also all the heat given off from it, is called a respiration calorimeter—that is, a machine for measuring both the respiratory products and the heat given off by the body. It is like the respiration apparatus, except that it is furnished with devices for measuring temperatures. Several have been built in Europe within the last twenty years, among the most successful being by Rubner and Rosenthal. One was recently built by the author and Professor Rosa at Wesleyan University. Its main feature is a copper-walled chamber 7 feet long, 4 feet wide, and 6 feet 4 inches high. This is fitted with devices for maintaining and measuring a ventilating current of air, for sampling and analyzing this air, for removing and measuring the heat given off within the chamber, and for passing food and other articles in and out. It is furnished with a folding bed, chair, and table, with scales and with appliances for muscular work, and has telephone connection with the outside. Here the subject stays for a period of from three to twelve days, during which time careful analyses and measurements are made of all material which enters the body in the food and of that which leaves it in the breath and excreta. Record is also kept of the energy given off from the body as heat and muscular work. The differences between the material taken into and that given off from the body is called the balance of matter, and shows whether the body is gaining or losing material. The difference between the energy of the food taken and that of the excreta and the energy given off from the body as heat and muscular work, is the balance of energy, and if correctly estimated should equal the energy of the body material gained or lost.

With such apparatus it is possible to learn what effect different conditions of nourishment will have on the human body. In one experiment, for instance, the subject might be kept quite at rest, and in the next do a certain amount of muscular or mental work, with the same diet as before. Then by comparing the results of the two the use which the body makes of its food under the different conditions could be determined. Or the diet may be slightly changed in one experiment and the effect of this on the balance of matter and energy observed. Such methods and apparatus are very costly in time and money, but the results are proportionately more valuable than those from simpler experiments.

FOOD AND FOOD ECONOMY.

What has thus far been said about the ingredients of food and the ways they are used in the body may be briefly summarized in the following schematic manner:

Nutritive ingredients (or nutrients) of food.

Food as purchased contains—
- Edible portion .... e. g., flesh of meat, yolk and white of eggs, wheat, flour, etc.
  - Water.
  - nutrients.
    - Protein.
    - Fats.
    - Carbohydrates.
    - Mineral matters.
- Refuse. e. g., bones, entrails, shells, bran, etc.

Uses of nutients in the body.

Protein .... e. g., white (albumen) of eggs, curd (casein) of milk, lean meat, gluten of wheat, etc.	Forms tissue......	All serve as fuel to yield energy in the forms of heat and muscular power.
Fats .... e. g., fat of meat, butter, olive oil, oils of corn and wheat, etc.	Are stored as fat	
Carbohydrates .... e. g., sugar, starch, etc.	Are transformed into fat..........	
Mineral matters (ash)...... e. g., phosphates of lime, potash, soda, etc.	Share in forming bone, assist in digestion, etc.	

The views thus presented lead to the following definitions: (1) Food is that which, taken into the body, builds tissues or yields energy; (2) the most healthful food is that which is best fitted to the needs of the user; (3) the cheapest food is that which furnishes the largest amount of nutriment at the least cost; and (4) the best food is that which is both most healthful and cheapest.

We have, then, to consider the kinds and amounts of nutrients in different food materials, their digestibility,

the kinds and amounts needed for nourishment by persons under different conditions of rest and work, and the nutritive value of different food products as compared with their cost.

COMPOSITION OF COMMON FOOD MATERIALS.

The value of food for nutriment depends mainly upon its composition and digestibility. The composition of foods is determined by chemical analysis. The first effective impulse to the systematic study of the chemistry of foods was given by Liebig somewhat over 50 years ago, but nearly all of our definite knowledge of the chemical composition of food materials has accumulated within comparatively a few years past.

Until about the year 1880 those who wished to know about the chemical composition of food materials were compelled to depend upon analyses of European products, and most of those analyses had been made in German laboratories. During the last two decades, however, American investigations have accumulated until at the present time the results of over 4,000 analyses of food materials from different parts of the United States are available. A large proportion of these analyses have been made during the last few years in connection with nutrition investigations under the auspices of the Department of Agriculture.

The methods of chemical analysis of foods are now so nearly uniform throughout the world that the analyses reported from different countries furnish a reliable means of comparing the composition of the food products of different parts of the world.

PROPORTIONS OF NON-NUTRIENTS IN FOODS.

It will be interesting to note some of the differences in food materials as shown by their composition. One of the first things which may be observed is the differences in the proportions of non-nutrients, i. e., refuse and water. Many kinds of food as they are purchased contain large amounts of refuse, as the skin and bones of meat and fish, the skin or rind and seeds of vegetables, etc., which necessarily lessen the proportion of nutrients. While such refuse is found in meats, fish, eggs, fresh vegetables and fruits, it is usually absent in the dairy products (milk, butter, cheese, etc.), dried vegetables, cereal foods (flour, breakfast foods, etc.), and the bread, cakes and other foods prepared from them. In considering the edible portion we find that the amount of water present also affects the nutritive value of food. Water is necessary to the body, and it is usually supplied in abundance by beverages, although the amount contained in the solid food consumed in a day is quite considerable. Water forms from 40 to 50 per cent. of the ordinary cuts of meat; it is especially abundant in the flesh of lean animals, and tends to decrease as fat increases, and vice versa. It is even more abundant in fresh fish than in meats, but in dried fish there is, of course, comparatively little. Fresh vegetables and fruits contain sometimes as much as 80 or 90 per cent. or more of water, while dried seeds and the food materials prepared from them (beans, peas, meals, flour, cereal breakfast foods, etc.) usually contain, roughly speaking, from 10 to 12 per cent. of water. Many cooked foods contain more water than the raw materials from which they are made, owing to the quantities added in cooking. Thus some thin soups are little more than flavored and colored water, and, of course, have an extremely low nutritive value. In other cooked foods, notably meat, which have been baked, roasted, or fried, the amount of water is diminished by cooking.

PROPORTIONS OF NUTRIENTS IN FOODS.

The most important of the actual nutrients has been seen to be protein. This occurs most abundantly in animal foods—meat, fish, eggs, and dairy products, and in the dried legumes, as beans and peas. Butter and lard are exceptions to this statement, as they represent the fat of milk and meat. The proportions of protein present in meats and fish varies greatly with the kind and cut. In beef, veal and mutton it composes between 14 and 26 per cent. of the edible portion. It is generally less abundant in the flesh of fish, because the latter is more watery than meat. The fatter the meat the smaller is the proportion of protein; lean pork has less than beef and mutton, and fat pork almost none. It is more abundant in cheese (28 to 38 per cent.) and likewise in dried beans and peas (18 to 25 per cent.). Protein makes up, roughly speaking, from 7 to 15 per cent. of the cereals, being least abundant in rye and buckwheat and most abundant in oats. Wheat flour averages not far from 11 per cent. and bread not far from 9 per cent. of protein. Fresh vegetables and fruits contain almost no protein, seldom if ever more than 5 and often only 1 per cent. or less.

The chief sources of fat in ordinary diet are the animal foods, though some fat is derived from vegetable foods. The quantities present in meats vary considerably, ranging from less than 10 per cent. in some cuts of beef and veal to over 40 per cent. in a side of pork and over 80 per cent. in fat salt pork. The leaner fish, like cod and haddock, usually contain almost none, but in the fatter kind, like shad, mackerel, and notably salmon, there is often from 5 to 10 per cent. and sometimes as much as 15 per cent. of fat. The chemical composition of salmon is not unlike that of lean meat. In both meat and fish the increase of fat usually means a decrease in the proportion of water, as was stated above. Milk averages about 4 per cent. of fat. Butter is, as we have seen, nearly pure fat, and whole milk cheese may have anywhere from 25 to 40 per cent. of fat, according to the richness of the cream or milk from which it is made.

The olive and the cotton seed are rich in fat, large quantities of them being used annually for the production of oils. Most of our common edible nuts also contain considerable fat. With the exception of oatmeal, which contains about 7 per cent., there is comparatively little fat in the cereals in the form in which they are ordinarily purchased, or in the dried legumes, while in the green vegetables and most fruits it is practically wanting.

The carbohydrates, unlike the fats, are almost entirely absent from the animal foods, except milk, but form the most important nutrient of most vegetable foods. Some glycogen (a carbohydrate) is found in the liver and in other animal tissues. The carbohydrates make up from 70 to 80 per cent. of the cereals, 60 to 70 per cent. of the dried legumes, and the bulk of the nutrients of fresh vegetables and fruits. The nutrients of sugar, molasses, honey, etc., are, of course, almost entirely carbohydrates.

Mineral matters occur in all the ordinary articles of food. Fresh meats and fish contain not far from 1 per cent., although in fat, unsalted pork the quantity may be as small as 0.1 per cent. Milk contains about 0.7 per cent. mineral matters. In the cereals the proportion ranges from about 0.3 to over 2 per cent., while in green vegetables and fruits it is usually less than 1 per cent. The dried legumes contain 3 to 4 per cent. of mineral matters.

In brief, then, it may be said that meats, fish, eggs, milk, fresh vegetables, and fruits contain the most

refuse and water; that protein is most abundant in the animal foods and in the legumes and occurs in considerable quantities in the cereals; that fats occur principally in the animal foods; that carbohydrates are found almost exclusively in the vegetable products and milk; and that small quantities of mineral matters are found in all food materials. The fuel value varies within wide limits, being greatest in those materials which contain the most fat and the least water.

DIGESTION, ASSIMILATION AND EXCRETION.

"We live not upon what we eat, but upon what we digest." Food as we buy it in the market, or even as we eat it, is not usually in condition to be made into body structure or used as body fuel. It must first go through a series of chemical changes by what is called digestion, which prepares it to be absorbed, taken into the blood and lymph, and carried to the parts of the body where is it needed. Digestion takes place in the alimentary canal, partly in the stomach, but more in the intestine. As the result, the useless portions are separated and rejected, while the parts which can serve for nutriment are changed into forms in which they can be absorbed, taken into the circulation and utilized.

DIGESTION.

The alterations which the food undergoes in digestion are brought about by substances called ferments, which are secreted by the digestive organs. The saliva in the mouth has the power of changing insoluble starches into soluble sugar, but as the food stays in the mouth only a short time, there is generally little chance for such action. The saliva, however, helps to fit the food to be more easily worked on by the stomach. The gastric juice of the stomach acts upon protein, and the pancreatic juice of the intestine upon protein, fats and carbohydrates. The action of all the ferments is aided by the fine division of the food by chewing and by the muscular contractions, the so-called peristaltic action, of the stomach and intestine. These latter motions help to mix the digestive juices and their ferments with the food.

The parts of the food which the digestive juices cannot dissolve, and which, therefore, escape digestion, are periodically given off by the intestine. Such solid excreta, or feces, include not only the particles of undigested food, but also the so-called metabolic products, i. e., residues of the digestive juices, bits of the lining of the alimentary canal, etc.

ABSORPTION AND ASSIMILATION.

The digested food finds its way through the walls of the alimentary canal, and at this time and later it undergoes remarkable chemical changes. When finally the blood, supplied with the nutrients of the digested food and freighted with oxygen from the lungs, is pumped from the heart all over the body it is ready to furnish the organs and tissues with the materials and energy which they need for their peculiar functions; at the same time it carries away the waste which the exercise of these functions has produced. It is a characteristic of living body tissue that it can choose the necessary materials from the blood and build them into its own structure. How it does this is one of the mysteries of physiology. The body, as we have learned, has also the power of consuming not only the materials of the food, but also parts of its own structure for the production of muscular work, or heat, or to protect more important parts from consumption. How it does this is another mystery, still to be explained.

EXCRETION.

After the material has been thus assimilated and utilized the resulting waste products must be removed from the body. The chemical elements which this waste contains are, of course, the same as those making up the structure of the body and the food—carbon, oxygen, hydrogen, nitrogen, calcium, phosphorus, sulphur, etc. Most of the carbon and part of the oxygen are given off from the lungs as carbon dioxid. Hydrogen unites with more oxygen to form water, which is passed off in vapor from the lungs, in perspiration from the skin, and in urine from the kidneys. Almost all the nitrogen is excreted in the urine. Waste mineral matters are given off to some extent in the perspiration, but mainly through the kidneys and intestines.

APPARENT AND ACTUAL DIGESTIBILITY.

The real nutritive value of a food, then, depends not simply on the proportions of nutrients which it contains, but also on the amount of those nutrients which can be made available to the body by digestion for building material and for fuel. Part of the food eaten escapes digestion and is given off from the body in the feces. If we subtract the amount of this undigested residue from the total food, the remainder will be the amount actually digested in the stomach and intestine, absorbed through their walls, and taken into the circulation. This difference between the amounts eaten and those undigested represents the actual digestibility of food. A part of the food taken into the circulation, however, is later returned again to the alimentary canal mainly in the digestive juices that are needed for digesting the food. The material thus removed from circulation and returned to the alimentary canal, which consists of so-called metabolic products, is excreted with the undigested residue in the feces. The remainder of the food taken into the circulation represents the amount retained by the body for building material and for fuel. The difference between the food which is absorbed and that which the body secures, therefore, is represented by the metabolic products. By the present methods of experimenting, however, the portion of the feces that consists of metabolic products cannot be satisfactorily distinguished from the undigested residue. It is very difficult, therefore, to determine the actual digestibility, but comparatively easy to estimate the apparent digestibility of food.

Suppose, for instance, that 15 per cent. of the protein in a specimen of bread is excreted, then 85 per cent. remains for the use of the body. If the bread has 8.4 per cent. of protein, 100 pounds will have 8.4 pounds, of which 85 per cent. or 7.1 pounds will be utilized by the body.

EASE AND QUICKNESS OF DIGESTION.

The terms digestible, indigestible, etc., as here used refer simply to the food which is or is not available for the general nourishment of the body after the process of digestion is completed. In common parlance, however, they are used more loosely as referring to the ease and quickness of digestion, and to the general healthfulness of food. One kind of food—bread, for instance—is spoken of as "simple" and "digestible," and another, like fruit cke, as "rich" and "indigestible." There is often much practical truth behind such statements, though little is definitely known concerning the time or labor required to digest different kinds of food.

Food does not ordinarily pass from the stomach into the intestine until it has been reduced to a liquid or semi-liquid condition. The length of time required for different foods to leave the stomach has been recently

studied by Penzoldt with healthy men. He used a stomach tube for removing the stomach contents for examination. He found that the amount and consistency of food have a marked influence on the rate of digestion in the stomach. Fluids leave the stomach more rapidly than other materials. From 6 to 7 ounces of water or other common beverages leave the stomach in 1½ hours. Seven ounces of boiled milk leave the stomach in about 2 hours. Hot drinks do not leave the stomach more quickly than cold ones, nor does the quantity have much effect. Solid matter in solution or suspension delayed the passage of fluid from the stomach somewhat. The consistency of solid foods thus seems to have more effect upon digestibility than the amount consumed. The quantity eaten increases the length of time the material remains in the stomach, but not proportionally.

To select a few examples of the time required for foods to leave the stomach: Two eggs (raw, poached, or in the form of an omelet), 7 ounces sweetbreads, 10 moderate sized oysters, 7 ounces whitefish, or 3½ ounces of white bread, cauliflowers, or cherries, each left the stomach in from 2 to 3 hours. Eight and one-fourth ounces of chicken, 9 ounces of lean beef, 6 ounces boiled ham, 3½ ounces roast veal or beefsteak, 5 1-3 ounces of coarse bread, boiled rice, carrots, spinach, radish, or apple, left the stomach in 3 to 4 hours. Nine ounces of smoked tongue, 3½ ounces beef, 9 ounces roast goose, 5 1-3 ounces string beans, or 7 ounces peas porridge, left the stomach in 4 to 5 hours.

Generally speaking, the most readily digested animal foods were materials of soft consistency. White meats —for example, chicken—leave the stomach more quickly than red meats or dark meat—for instance, duck. The method of cooking also exerts a very marked influence on stomach digestion. Fresh fish was found to be more readily digested than meats.

As regards vegetable foods in general, the consistency and the amounts of solid material were again the principal factors affecting the time required for digestion in the stomach. Mealy potatoes, for instance, were more easily digested than waxy potatoes, and mashed potato more readily than potato cut up in pieces. Fine bread was more quickly digested than coarse bread. There was not much difference in the time required for bread crust, bread crumb, toast, new bread and stale bread to digest in the stomach, provided all were equally well chewed.

It must be remembered that digestion continues in the intestine and that the total time required for the digestion and absorption of the nutrients in any given food material is not shown by such experiments. They find their chief application in prescribing a diet for invalids, as in such cases it is often desirable to require of the stomach only a limited amount of work.

AGREEMENT OF FOOD WITH INDIVIDUALS.

Digestibility is often confused with another very different thing, namely, the agreeing or disagreeing of food with the person who eats it. During the process of digestion and assimilation the food, as we have seen, undergoes many chemical changes, some of them in the intestines, some in the liver, muscles, and other organs. In these changes chemical compounds may be formed which are in one way or another unpleasant and injurious, especially if they are not broken down (as normally they are) before they have opportunities thus to act. Some of the compounds produced from the food in the body may be actually poisonous.

Different persons are differently constituted with respect to the chemical changes which their food undergoes and the effect produced so that it may be literally true that "one man's meat is another man's poison." Milk is for most people a very wholesome, digestible and nutritious food, but there are persons who are made ill drinking it, and they should avoid milk. The writer knows a boy who is made seriously ill by eating eggs. A small piece of sweet cake in which eggs have been used will cause him serious trouble. The sickness is nature's evidence that eggs are for him an unfit article of food. Some persons have to avoid strawberries. Indeed, cases in which the most wholesome kinds of food are hurtful to individual persons are, unfortunately, numerous. Every man must learn from his own experience what food agrees with him and what does not.

How much harm is done by the injurious compounds sometimes formed from ordinary wholesome foods is seldom realized. Physiological chemistry is revealing the fact that these compounds may affect even the brain and nerves, and that some forms of insanity are caused by products formed by the abnormal transformations of food and body material.

PROPORTIONS OF DIGESTIBLE NUTRIENTS IN FOOD MATERIALS.

During the past few years many experiments have been made to test the proportions of nutrients digested from ordinary food materials. In making the experiments the subjects are kept on a simple diet, all the food and solid excreta are analyzed, and the difference between the two is taken to represent the amount of food which the body secures for nutriment. Most of the subjects have been people in good health; the great majority have been men, but a few women, and especially children.

From comparison of the results of many such experiments much interesting knowledge has been gained of the relative digestibility of different kinds and classes of foods.

In general it may be said that probably most foods used by man are more completely digested than is ordinarily supposed, so that the bulk of the intestinal excretion is made up of metabolic products. Some foods, however, contain large proportions of material upon which the digestive juices cannot so act as to make them capable of being absorbed. Thus the outer hull of the wheat grain contains woody substance which passes through the alimentary canal of man undigested, though animals, like cows and sheep, can digest a large part of it.

It has been found that in the total food of an ordinary mixed diet, on the average, about 92 per cent. of the protein, 95 per cent. of the fats and 97 per cent. of the carbohydrates are retained by the body. In the average proportions in which the different animal and vegetable foods are combined in the diet about 97 per cent. of the protein, 95 per cent. of the fats and 98 per cent. of the carbohydrates of the animal foods are digested, while only 84 per cent. of the protein, 90 per cent. of the fats and 97 per cent. of the carbohydrates of the vegetable foods are digested. Animal foods, therefore, seem to have a greater digestibility than vegetable, especially as regards the protein they contain. The digestibility of a given article of food depends, of course, upon the digestibility of the different classes of nutrients and upon the relative proportion in which these nutrients occur. Thus, of two cereals containing about the same amount of dry matter, but with different proportions of protein and carbohydrates, the one with the larger proportion of the less digestible protein and the smaller proportion of the more digestible carbohydrates will be, on the whole, less completely digested.

The proportions of the several nutrients which the

body retains for its use are commonly called percentages or coefficients of digestibility.

PREPARATION OF FOOD—COOKING.

The cooking of food has much to do with its nutritive value. Many articles which, owing to their mechanical condition or other cause, are quite unfit for nourishment when raw are very nutritious when cooked. It is also a matter of common experience that a well-cooked food is wholesome and appetizing, while the same material badly cooked is unpalatable. There are three chief purposes of cooking. The first to change the mechanical condition so that the digestive juices can act upon the food more freely. Heating often changes the structure of food materials very materially, so that they are more easily chewed and more easily and thoroughly digested. The second is to make it more appetizing by improving the appearance or flavor, or both, Food which is attractive to the taste quickens the flow of saliva and other digestive juices, and thus digestion is aided. The third is to kill by heat any disease germs, parasites, or other dangerous organisms it may contain. This is often a very important matter, and applies to both animal and vegetable foods.

The cooking of meats develops the pleasing taste and odor of extractives and that due to the browned fat and tissues and softens and loosens the protein (gelatinoids) of the connective tissues, and thus makes the meat more tender. Extreme heat, however, tends to coagulate and harden the albumenoids of the lean portions, and also weakens the flavor of extractives. If the heating is carried too far a burned or charred product of bad flavor results.

Meats lose weight in cooking. A small part of this is due to escape of meat juices and fat, but the chief part of the material lost is simply water. The nutritive value of a meat soup depends upon the substances which are dissolved out of the meat, bones and gristle by the water. In ordinary meat broth these consist almost wholly of extractives and salts, which are very agreeable and often most useful as stimulants, but have little or no value as actual nutriment, since they neither build tissue nor yield energy. The principles which underlie the cooking of fish are essentially the same as with meats.

In many vegetables the valuable carbohydrates, chiefly microscopic starch grains, are contained in tiny cells with thick walls on which the digestive juices have little effect. The heat of cooking, especially with the aid of water, ruptures these walls and also makes the starch more soluble. The heat also caramelizes a portion of the carbohydrates and produces agreeable flavors in this and other ways.

In breads, cakes, pastry and other foods prepared from flour, the aim is to make a palatable and lighter porous substance more easily broken up in the alimentary canal than the raw materials could be. Sometimes this is accomplished simply by means of water and heat. The heat changes part of the water in the dough into steam, which, in trying to escape, forces the particles of dough apart. The protein (gluten) of the flour stiffens about the tiny bubbles thus formed and the mass remains porous even after the steam has escaped. More often, however, other things are used to "raise" dough—such as yeast and baking powder. The baking powder gives off the gas carbon dioxid and the yeast causes fermentation in the dough by which carbon dioxid is produced. This acts as the steam does, only much more powerfully. When beaten eggs are used, the albumen incloses air in bubbles which expand, and the walls stiffen with the heat and thus render the food porous.

Scrupulous neatness should always be observed in keeping, handling, and serving food. If ever cleanliness is desirable, it must be in the things we eat, and every care should be taken to insure it for the sake of health as well as of decency. Cleanliness in this connection means not only absence of visible dirt, but freedom from undesirable bacteria and other minute organisms, and from worms and other parasites. If food, raw or cooked, is kept in dirty places, peddled from dirty carts, prepared in dirty rooms and in dirty dishes, or exposed to foul air, disease germs and other offensive and dangerous substances can easily get in.

Food and drink may, in fact, be very dangerous purveyors of disease. The bacteria of typhoid fever sometimes find their way into drinking water, and those of typhoid and scarlet fevers and diptheria into milk, and bring sickness and death to large numbers of people. Oysters which are taken from the salt water where they grow and "floated" for a short time in brackish water near the mouth of a stream, have been known to be infected by typhoid fever germs brought into the stream by the sewage from houses where the dejections from patients had been thrown into the drains. Celery or lettuce grown in soil containing typhoid germs has been thought to convey this disease.

Food materials may also contain parasites, like tapeworm in beef, pork and mutton, and trichinæ in pork, which are often injurious and sometimes deadly in their effect. This danger is not confined to animal foods. Vegetables and fruits may become contaminated with eggs of numerous parasites from the fertilizers applied to them. Raw fruits and vegetables should always be very thoroughly washed before serving if there is any doubt as to their cleanliness. If the food is sufficiently heated in cooking, all organisms are killed.

Sometimes food undergoes decomposition in which injurious chemical compounds, so-called ptomaines, are formed. Poisoning by cheese, ice cream, preserved fish, canned meats, and the like has been caused in this way. The ptomaines often withstand the heat of cooking.

In some cases it has been found that foods are adulterated with compounds injurious to health; but sophistication in which harmless articles of inferior cost or quality are added is more common.

Dainty ways of serving food have a usefulness beyond their æsthetic value. Everyone knows that a feeble appetite is often tempted by a tastefully garnished dish, when the same material carelessly served would seem quite unpalatable. Furthermore, many cheap articles and "left-overs" when well seasoned and attractively served may be just as appetizing as dearer ones, and will usually be found quite as nutritious.

DIETARIES AND DIETARY STANDARDS.

The information gained from a study of the composition and nutritive value of foods may be turned to practical account by using it in planning diets for different individuals or classes of individuals or in estimating the true nutritive value of the food actually consumed by families or individuals. By comparing the results of many such investigations with the results of accurate physiological experimenting it is possible to learn about how much of each of the nutrients of common foods is needed by persons of different occupations and habits of life, and from this to compute standards representing the average requirements for food of such persons.

METHODS OF MAKING DIETARY STUDIES.

During the last twenty years much of this practical application of the chemistry of food has been made in the study of actual dietaries. Much work of this kind

has been done in England, Germany, Italy, Russia, Sweden, and elsewhere in Europe, and in Japan and other oriental countries. Within the past dozen years extensive studies have been made in the United States. The simplest way of making such inquiries is to find out what kinds and quantities of food are used during a given period in the household in which the study is made; to estimate the amounts of various nutrients which the different materials contain by means of figures given for the average composition of the various articles in tables, and then to calculate the cost and amount of nutrients for each person. There are, however, several chances for error in such a method. In the first place, since different specimens of the same kind of food vary greatly in composition, it is often inaccurate to estimate the nutrients of one specimen from figures representing the average composition. Accordingly, in the more careful dietary studies, the composition of the food is determined by analyzing samples of materials actually used. Again, this method assumes that all the food is really consumed, whereas it is very plain that frequently no small portion is wasted in the kitchen or at the table. This difficulty is usually met by measuring and computing the amounts of nutrients in the waste and sometimes by analyzing samples of it.

In preparing the results of dietary studies so that different studies may be compared, another difficulty appears. For example, in a family consisting of father, mother and two children of diffent ages, the amount of food taken by each is by no means the same, and it would be quite incorrect to divide the whole amounts consumed by four and call the result the amount used per person. Men, as a rule, eat more than women, women more than young children, and persons of active habits more than those who take little muscular exercise. A coal heaver, who is constantly using up nutritive material of muscular tissue to supply the energy required for his severe muscular work, needs a diet with more protein and higher fuel value than a bookkeeper who sits at a desk all day. It is ordinarily estimated that, as compared with a man at moderate or light work, a woman under similar conditions needs 0.8 as much food, and children amounts varying with their ages, and such figures are used to reduce the statistics of a dietary to the standard of one man at moderate work. The various factors commonly used in the United States in computing the results of dietary studies are as follows:

Factors used in calculating meals consumed in dietary studies.

Man at hard muscular work requires 1.2 the food of a man at moderately active muscular work.
erately active muscular work.
Man with light muscular work and boy 15-16 years old require 0.9 the food of a man at moderately active muscular work.
Man at sedentary occupation, woman at moderately active work, boy 13-14, and girl 15-16 years old require 0.8 the food of a man at moderately active muscular work.
Woman at light work, boy 12, and girl 13-14 years old require 0.7 the food of a man at moderately active muscular work.
Boy 10-11 and girl 10-12 years old require 0.6 the food of a man at moderately active muscular work.
Child 6-9 years old requires 0.5 the food of a man at moderately active muscular work.
Child 2-5 years old requires 0.4 the food of a man at moderately active muscular work.
Child under 2 years old requires 0.3 the food of a man at moderately active muscular work.

These factors are based in part upon experimental data and in part upon arbitrary assumptions. They are subject to revision when experimental evidence shall warrant more definite conclusions.

In making dietary studies in this country blanks are usually prepared to be filled out with statistics of the amounts, kinds, cost and estimated nutrients of the food purchased, wasted and actually consumed, and information concerning the number, sex, age, and occupation of the persons for whom the food is provided. If further data are gathered concerning the health, nationality, income and general conditions of the individuals of families, the results of such inquiries have a wider physiological and sociological bearing. These supplementary statistics have been collected in considerable detail in late studies in the United States.

AMERICAN AND EUROPEAN DIETARIES AND DIETARY STANDARDS.

Many interesting things come to light on comparing the dietaries of persons with different occupations and incomes and performing different amounts of muscular work. A comparison of the dietaries of the inhabitants of different countries is also interesting. Such comparisons are made in the following table, which includes as well the commonly accepted dietary standards. The figures show the quantities of both total and available nutrients. The fuel value represents the actual amount of available energy, and may be computed from either the total of the digestible nutrients by use of appropriate factors.

The dietary standards given by the table herewith are based, as far as possible, upon the results of observation and experiment, but are at best general estimates and not guides to be blindly followed. They are subject to revision in the light of further experimental evidence. It will be observed that the amounts of energy provided in the American standards are somewhat larger than in the European standards (Voit's). This corresponds to the observed fact that people in this country, more especially the working people, are as a rule better fed and do more work than those of corresponding classes in Europe. The quantities of protein in these standards are larger in proportion to the fuel ingredients—that is, the nutritive ratio is narrower—than is found in the average American diet. In this respect the standards agree more nearly with the diet of well-to-do people in Europe. It is believed that the larger amount of protein represents rather more nearly a physiological ration than do the proportions as found in the majority of actual dietaries.

The results of a large amount of experimental investigation bear out the common belief that the American, as a rule, uses more food than the European of the same class. The character of the food is, however, quite different. The poor peasants of Russia and northern Germany live chiefly upon rye bread, potatoes, and some sort of fat. In Italy maize, chestnuts, and acorn meal form an important item in the diet of a considerable portion of the poorer population. The use of meat among the working population of most European and Asiatic countries is very much less than in America, because its cost is prohibitive.

In the majority of European dietaries the fats occur in relatively smaller and carbohydrates in relatively larger amounts than in American dietaries. This is probably due in large measure to the smaller quantities of meats used in the former dietaries.

Among the more scantily nourished peoples of the globe are the poor of India and China. They live largely on rice and other cereals and vegetables, with more or less of pulse and other legumes, and often on quantities which to the ordinary American would seem little more than a starvation diet.

A close examination of detailed statistics shows that, although there may be occasional wide variations between two individuals of a given class in respect to the total amounts of food eaten, yet, on the whole, through

extended periods, there are not unusually large variations in amounts of protein or energy in the food consumed by different individuals of the same class; that is, under similar conditions as regards work or rest.

MAKING HOME STUDIES OF DIETARIES.

Any housekeeper who wishes to know how the nutritive value of the food she provides for her family corresponds with the dietary standards can easily make a simple dietary study in her home, and by so doing can perhaps not only provide meals that are more in accordance with the needs of her family, but frequently also save money by substituting less expensive but equally nutritious and attractive food materials for some of those usually served.

The simplest way to make such a study is to weigh all different kinds of food materials in the house at a given time, say after supper, recording the weights in a convenient book. All the food purchased during the days during which the diet is being studied is weighed and recorded, and at the close of the study, which may be conveniently of seven or ten days duration, all food materials remaining on hand are weighed as before. From the quantities of the different kinds of food on hand at the beginning and purchased during the period are subtracted the quantities left on hand at the close of the study. The difference represents the amounts used. In order to express the quantities of nutrients in values per man per day, the number of meals taken by different members of the family are multiplied by the factors, pointing off one decimal place. The result gives the equivalent number of meals for a man. The equivalent number of meals taken divided by 3 gives the equivalent number of days for one man. The total nutrients for the whole period, divided by this latter quantity, gives the nutrients per man per day. From these latter figures the fuel value of the diet can be computed by means of the factors. In a similar way the value of any menu for one day or one meal may be calculated. It is to be remembered that in a short period, such as a day or two days, the diet may fluctuate according to the materials used so as to give more of one kind of nutrients and less of another, or more or less total nutrients than the average diet, while in periods of a week or ten days the diet is more likely to approach an average.

FOOD CONSUMPTION OF PERSONS IN DIFFERENT CIRCUMSTANCES, AND PROPOSED DIETARY STANDARDS.
(Quantities per man per day.)

	Number of studies included in averages.	Actually eaten. Protein.	Actually eaten. Fat.	Actually eaten. Carbo-hydrates.	Digestible. Protein.	Digestible. Fat.	Digestible. Carbo-hydrates.	Fuel value.	Nutritive ratio.
PERSONS WITH ACTIVE WORK.		Gms.	Gms.	Gms.	Gms.	Gms.	Gms.	Cal'ri's	
Rowing clubs in New England	7	155	177	440	143	168	427	3,955	5.6
Bicyclists in New York	3	186	186	651	171	177	631	5,005	6
Football teams in Connecticut and California	2	226	354	634	208	336	615	6,590	6.6
Prussian machinists	1	139	113	677	128	107	657	4,270	7
Swedish mechanics	5	189	110	714	174	104	693	4,590	5.3
PERSONS WITH ORDINARY WORK.									
Farmers' families in eastern United States	10	97	130	467	89	124	453	3,415	8.2
Mechanics' families in United States	14	103	150	402	95	143	390	3,355	7.5
Laborers' families in large cities of United States	12	101	116	344	93	110	334	2,810	6.3
Laborers' families in U. S. (more comfortable circumstances)	2	120	147	534	110	140	518	3,925	7.6
Russian peasants	..	129	33	589	119	31	571	3,165	5.4
Swedish mechanics	6	134	79	523	123	75	507	3,330	5.5
PROFESSIONAL MEN.									
Lawyers, teachers, etc., in United States	14	104	125	423	96	119	410	3,220	7.1
College clubs in United States	15	107	148	459	98	141	445	3,580	7.8
German physicians	2	131	95	327	121	90	317	2,680	4.3
Japanese professor	1	123	21	416	113	19	403	2,345	4
MEN WITH LITTLE OR NO EXERCISE.									
Men (American) in respiration calorimeter	11	112	80	305	103	76	296	2,380	4.5
Men (German) in respiration apparatus	5	127	80	302	117	76	293	2,430	4
PERSONS IN DESTITUTE CIRCUMSTANCES.									
Poor families in New York City	11	93	95	407	86	90	395	2,845	6.9
Laborers' families in Pittsburg, Pa	2	80	95	308	74	90	299	2,400	6.8
German laborer's family	1	52	32	287	48	30	278	1,640	7.2
Italian mechanics	5	76	38	396	70	36	384	2,225	6.6
MISCELLANEOUS.									
Negro families in Alabama and Virginia	39	86	145	440	79	138	427	3,395	9 3
Italian families in Chicago	4	103	111	391	95	105	379	2,965	6.5
French Canadians in Chicago	5	118	158	345	109	150	335	3,260	6.2
Bohemian families in Chicago	8	115	101	360	106	96	349	2,800	5.3
Inhabitants Java village, Columbian Exposition, 1893	1	66	19	254	61	18	246	1,450	4.7
Russian Jews in Chicago	10	137	103	418	126	98	405	3,135	5
Mexican families in New Mexico	4	94	71	613	86	67	595	3,460	8.7
Chinese dentist in California	1	115	113	289	106	107	280	2,620	4.9
Chinese laundryman in California	1	135	76	566	124	72	549	3,480	5.7
Chinese farm laborer in California	1	144	95	640	132	90	621	3,980	6.2
United States Army ration, peace	..	120	161	454	110	153	440	3,730	7.1
German Army ration, peace	..	114	39	480	105	37	466	2,725	5.2
DIETARY STANDARDS.									
Man at hard work (Volt)	..	145	100	450	133	95	437	3,270	4.9
Man at moderate work (Volt)	..	118	56	500	109	53	485	2,965	5.5
Man with very hard muscular work (Atwater)	..	175	...	...	161	...	...	5,500	7.2
Man with hard muscular work (Atwater)	..	150	...	...	138	...	...	4,150	6.2
Man with moderately active muscular work (Atwater)	..	125	...	...	115	...	...	3,400	6.2
Man with light to moderate muscular work (Atwater)	..	112	...	...	103	...	...	3,050	6.1
Man at sedentary or woman with moderately active work (Atwater)	..	100	...	...	92	...	...	2,700	6.1
Woman at light to moderate muscular work, or man without muscular exercise (Atwater)	..	90	...	...	83	...	...	2,450	6.1

ADAPTING FOOD TO THE NEEDS OF THE BODY.

All persons are alike in that they must have protein for the building and repair of the bodily machine and fuel ingredients for warmth and work, but individuals differ in the amounts and proportions they require, and even among those in good health there are many who are obliged to avoid certain kinds of food, while invalids and people with weak digestion must often have special diet.

For people in good health and with good digestion there are two important rules to be observed in the regulation of the diet. The first is to choose the things which "agree" with them, and to avoid those which they cannot digest and assimilate without harm. The second is to use such kinds and amounts of food as will supply all the nutrients the body needs and at the same time avoid burdening it with superfluous material to be disposed of at the cost of health and strength.

For guidance in this selection, nature provides us with instinct, taste and experience. Physiological chemistry adds to these the knowledge—still new and far from adequate—of the composition of food and the laws of nutrition. In our actual practice of eating we are apt to be influenced too much by taste—that is, by the dictates of the palate; we are prone to let natural instinct be overruled by acquired appetite, and we neglect the teachings of experience. We need to observe our diet and its effects more carefully and to regulate appetite by reason. In doing this we may be greatly aided by the knowledge of what our food contains and how it serves its purpose in nutrition.

Though there may be differences among abnormal persons, for the great majority of people in good health the ordinary food materials—meats, fish, eggs, milk, butter, cheese, sugar, flour, meal and potatoes and other vegetables—make a fitting diet, and the main question is to use them in the kinds and proportion fitted to the actual needs of the body.

When more food is eaten than is needed, or when articles difficult of digestion are taken, the digestive organs are overtaxed, if not positively injured, and much energy is thus wasted which might have been turned to better account. The evils of overeating may not be felt at once, but sooner or later they are sure to appear—perhaps in an excessive amount of fatty tissue, perhaps in general debility, perhaps in actual disease. The injurious effects of food which does not "agree" with a person have already been pointed out.

ADVANTAGES OF SEVERAL MEALS A DAY.

The theory is advanced from time to time that one or two meals a day are preferable to the three commonly served in this country. If the same amount of food is to be eaten it is hard to see the advantage of two very hearty meals over three ordinary ones. The best physiological evidence implies that moderate quantities of food taken at moderate intervals are more easily and completely digested by ordinary people than larger quantities taken at long intervals. If the food ordinarily taken is considered excessive and the aim is simply to reduce the amount, it would seem more rational to make all the meals lighter than to leave out one. The very fact that the custom of eating a number of meals a day has so long been almost universal indicates that it must have some advantages which instinct, based upon experience, approves and justifies.

PECUNIARY ECONOMY OF FOOD.

Although the cost of food is the principal item of the living expenses of a large majority of the people, and although the physical welfare of all is so intimately connected with and dependent upon diet, very few of even the most intelligent have any clear ideas regarding the actual nutriment in the different food materials they use. In too many cases even those who wish and try to economize know very little as to the combinations which are best fitted for their nourishment and have still less information as to the relation between the real nutritive value of different foods and their cost.

The question here to be considered is this: Of the different food materials which are palatable, nutritious, and otherwise suited for nourishment, what ones are pecuniarily the most economical; in other words, what ones furnish the largest amounts of available nutrients at the lowest cost? In answering this question it is necessary to take into account not only the prices per pound, quart, or bushel of the different materials, but also the kinds and amounts of the actual nutrients they contain and their fitness to meet the demands of the body for nourishment. The cheapest food is that which supplies the most nutriment for the least money. The most economical food is that which is cheapest and at the same time best adapted to the needs of the user.

There are various ways of comparing food materials with respect to the relative cheapness or dearness of their nutritive ingredients. Of course the amount of energy that would be obtained in a quantity of any given material sufficient to furnish a pound of protein would vary with the amounts of fats and carbodydrates accompanying the protein; and on the other hand, the quantities of the different materials that would furnish 1,000 calories of energy would contain different amounts of protein. The figures for cost of protein leave the carbohydrates and fats out of account, and those for energy take no account of the protein. Hence the figures for either protein or energy alone give a very one-sided view of the relation between nutritive value and money cost.

The market price of food materials is not regulated by their actual value for nutriment. For instance, an ounce of protein or fat from the tenderloin of beef is no more nutritious than that from a round or shoulder, but it costs considerably more. The agreeableness of food to the palate or to the buyer's fancy has much to do in deciding current demand and consequent selling price. It may be said, however, that animal foods have some advantage over vegetable foods. Animal foods, such as meats, fish, milk, and the like gratify the palate as many vegetable foods do not. Furthermore, what is of still greater weight in regulating the food habits of communities by whose demand the prices are determined, they satisfy an actual need by supplying protein and fats in which the vegetable foods, except cereal grains and leguminous seeds, are largely lacking. Moreover, as has previously been explained, the animal foods are in general more easily and completely digested than are the vegetable, especially as regards protein. Thus there is doubtless good ground for paying somewhat more for the same total quantity of nutritive material in the animal food.

One point to be especially noted here is the difference in the cost of nutrients in foods already prepared for use and in the same materials not so prepared. For instance, wheat made into ordinary prepared breakfast cereal might contain no more available protein or energy than the same wheat made into white or graham flour, but the breakfast cereals cost more than the flour per pound. At the same time, the breakfast foods afford a pleasing variety in the diet, and often require little or no cooking and are, therefore, very convenient; while the flour must be made into bread or other food at more expense of labor, fuel, etc. If the breakfast cereal does not cost much more than the flour the difference may be offset by the convenience of preparation for the table, the palatability, and the pleasing variety it gives.

Many of the breakfast foods are advertised as having an especially high nutritive value. If the statements

often made in advertising these could be believed they would have some nutritive property not found in flours and meals ground from the same grains. For these claims there is no ground. The breakfast foods made from wheat, corn, oats, and other cereals, contain no nutritive material other than that which is in the original, and which is also found in the ordinary flours and meals made from the same grains; and when the two kinds of food are equally well cooked there is no experimental evidence to show any difference in the thoroughness of digestibility. The retail prices of the breakfast foods are from two to five times as large as those of the ordinary products, like flour and meal. The advertisements, which often claim nutritive values that are fictitious, do not give any suggestion of the high price of the nutrients in the prepared foods as compared with that of the same amounts in the ordinary products, nor do purchasers generally realize how expensive these prepared foods are.

ERRORS IN FOOD ECONOMY.

Scientific research, interpreting the observations of practical life, indicates that a fourfold mistake in food economy is very commonly made. First, the costlier kinds of food are used when the less expensive are just as nutritious and can be made nearly or quite as palatable. Secondly, the diet is apt to be one-sided, in that foods are used which furnish relatively too much of the fuel ingredients and too little of the flesh-forming materials. Thirdly, excessive quantities of food are used; part of the excess is eaten and often to the detriment of health; part is thrown away in the table and kitchen wastes. Finally, serious errors in cooking are committed.

For the well-to-do the worst injury is that to health; but people of small incomes suffer the additional disadvantage of the injury to purse. Indeed, to one who looks into the matter it is surprising to see how much people of limited incomes lose in these ways. It is the poor man's money that is most injudiciously spent in the market and the poor man's food that is most badly cooked at home.

NEEDLESS USE OF EXPENSIVE FOODS.

A common mistake in purchasing food is in buying the more expensive kinds when cheaper ones would serve the purpose just as well. This is often done under the impression that there is some peculiar virtue in the costlier materials and that economy in the diet is detrimental to dignity and welfare. Unfortunately it is too often the case that those who are most extravagant in this respect are the ones who can least afford it. On the other hand, there is frequently a desire to economize, but a lack of knowledge of the best method of doing so. Many a housekeeper who sincerely tries to do the best for those to be provided for, but whose every cent must tell, buys eggs at 25 a dozen, or sirloin steak at 20 cents a pound, when, for the same amount of money, it would be possible to get twice as much nourishment from a cheap cut of meat, which, with a little skill in preparation and cooking, could be made into a tasty dish such as persons in far easier circumstances would not hesitate to set upon their tables.

The difficulty is the ignorance of the simple principles of nutrition. That ignorance results in a great waste of money. The maxim "that the best is the cheapest," as popularly understood to apply to the higher-priced materials, is not true of food. The larger part of the price of the costlier foods is paid for appearance, flavor, or rarity. While the dearer articles are often more pleasing to the palate, and are sometimes more easily cooked or possess a finer flavor, they are no more digestible nor nutritious than the cheaper ones. People who can afford them may be justified in buying them, but for persons in good health and with limited means they are not economical, and often increase the cost of food out of all proportion to nutrients furnished.

In the course of some dietary studies made in one of the poorer districts of Chicago it was found that a woman, whose husband was out of work and whose family was living on a few cents a day, bought lettuce, an article so innutritious that, at least when out of season and high in price, it is a luxury even for the rich, while she had to do without nutritious food. No one can object to the use of lettuce, or any other wholesome food, when the purse allows, but it is pitifully bad economy in such cases to buy foods which simply please the palate while the body goes without proper nourishment.

The plain, substantial, standard food materials, like the cheaper cuts of meat and fish, milk, flour, cornmeal, oatmeal, beans, and potatoes, are as digestible and nutritious and as well fitted for the nourishment of people in good health as are any of the costlier materials.

We endeavor to make our diet suit our palate by paying high prices in the market rather than by skillful cooking and tasteful serving at home. The remedy for this evil will be found in an understanding of the elementary facts regarding food and nutrition, in a better knowledge of cooking and serving food, and in the acceptance of the doctrine that economy is not only respectable but honorable.

The soup kitchens which have been established in many cities, where meals planned according to accepted dietary standards are sold at very low and yet profitable rates, should furnish their patrons with object lessons on the food-purchasing power of money.

DANGER OF A ONE-SIDED DIET.

Unless care is exercised in selecting food a diet may result which is one-sided or badly balanced—that is, one in which either protein or fuel ingredients are provided in excess. If a person consumes large amounts of meat and little vegetable food, the diet will be too rich in protein and may be harmful. On the other hand, if pastry, butter, and such foods are eaten in preference to a more varied diet, the food will furnish too much energy and too little building material.

Extreme illustrations of such a one-sided diet are found in the food of those persons who live largely on bread and tea, or others who live on cornmeal, fat pork, and molasses. The "hog and hominy" diet supplies liberal quantities of energy, but is very deficient in protein, as illustrated by the diet of negroes in the "black belt," with 62 grams of protein and 3,270 calories of energy per man per day.

In this connection it should be said that most of our dietary standards have been deduced from food investigations conducted with persons living in temperate climates. It is not improbable that those living in Arctic regions and in the Tropics require nutrients in different proportions. It is a matter of common observation that in Arctic regions much larger amounts of energy-yielding material, principally fat, are consumed than in warmer climates. Less definite information is available regarding the food requirements in the Tropics; but it seems probable that when proper dietary conditions are followed somewhat less food is consumed than in temperate regions, and that the nutrients are in somewhat different proportion. It is certain that a diet which would be entirely satisfactory in frigid regions would

be one-sided in the Tropics, and vice versa. This subject is one which needs further investigation before definite conclusions can be drawn regarding the foods best fitted for extremes of heat or cold.

WASTE OF FOOD.

The use of excessive quantities of food, which is a common dietary error in this country, among not only the well to do but also those in moderate circumstances, entails a waste of food in at least three ways:

First. More food is eaten than can be properly utilized by the body. This is not universally true, for there are some people who do not eat enough for healthful nourishment. But the eating habits of large numbers are vicious, resulting not only in a loss of food material but in an increase in the labor of digestion, to say nothing of the injurious effects which overeating may have upon the bodily organs and functions and upon health in general. Probably the worst sufferers from this evil are well-to-do people of sedentary occupations—brain workers as distinguished from hand workers.

Second. More food is served than can be eaten, and the excess is thrown away as table waste. Indeed, in many families in this country it is a matter of pride to furnish more than is needed, a feeling which appears quite unreasonable to frugal Europeans, even those in equally comfortable circumstances.

Third. The third form is that which occurs in the preparation of food materials for consumption. Thus, in removing the inedible material, as skin, seeds, etc., from fruits and vegetables, more or less of the edible portion is removed also, depending upon the care with which the work is done. The greatest loss from a pecuniary standpoint, however, is in the waste of animal foods in which the nutrients are in their costliest forms. The "trimmings" of meat which are left with the butcher or removed in the kitchen frequently contain one-eighth of the nutritive ingredients of the material paid for. Part of such waste is inevitable, but much of the valuable nutrients might be saved if the materials were used for making soup. The more economical cuts of meats are those in which there is less waste of this kind; in such cuts of meat as loin of beef, rib chops of lamb, and similar cuts, one-fifth the cost goes to pay for bone. Such cuts, therefore, should be avoided by those who wish to get the most actual nutriment for their money.

Just where and among what classes of people the waste of food is greatest it is not possible to say, but there is certainly a great deal more of it in this country than in Europe. The worst sufferers from it are doubtless the poor, but the large body of people of moderate means, the intelligent, and fairly well-to-do wage-workers are guilty of errors in this regard. The common remark that "the average American family wastes as much food as a French family would live upon" is greatly exaggerated, but statistics show that there is considerable truth in it. In dietary studies conducted at a students club in an Eastern college it was found that 10 to 14 per cent. of the nutritive materials purchased were thrown away as kitchen or table waste, and yet the club members were trying to live as economically as was consistent with comfort. In private families the waste has been found to range from practically none to as high as 8 or 10 per cent., while in boarding houses, even where economy was sought, it has reached 10, and individual instances 20 per cent.; and in some public institutions where large numbers were fed it has been as high as 25 per cent. and even higher.

ERRORS IN COOKING.

It is commonly remarked by those who study the conditions of living of people of limited means in different parts of the country that for substantial improvement of their household economies two things are needed. They must be informed as to the high nutritive value of the cheaper foods as compared with the costlier kinds, and the methods of cooking must be improved. A great deal of fuel is wasted in the preparation of food, and even then a great deal of the food is badly cooked. To replace dear food badly cooked by cheaper food well cooked is important for both health and purse. To make the table more attractive will be an efficient means for making the home life more enjoyable.

SUMMARY.

Food has been briefly defined as "that which taken into the body, either builds tissue or yields energy." In its building function protein is the most important ingredient of food, as it is the basis of muscle, bone, and almost all the tissues and fluids of the body. Mineral matters are also needed in the body structure, though in smaller quantities. Protein, fats, and carbohydrates may any of them be burned in the body to produce heat or muscular energy, but for protein this is a less important and probably less usual function. The fats and carbohydrates, by being themselves used as fuel, leave the protein for its indispensable work of tissue forming.

Not only the amounts of nutritive ingredients which a food contains, but also the proportions which can be digested and utilized by the body, determine the real nutritive value of a food material. As a general rule, carbohydrates are more completely digested and hence more fully available for use in the body than protein and fats, and protein of animal foods, as meat, fish, milk and eggs, is more digestible than that of vegetable foods. Fats are probably less digestible than most forms of protein and carbohydrates.

In ordinary mixed diet the chief sources of protein are meat, fish, and milk among animal foods, and the cereals and legumes among vegetable foods. Beans, peas and oatmeal are rich in protein and hence especially valuable food. About nine-tenths of the fat in the ordinary diet is obtained from the animal foods, while the vegetable foods furnish approximately nine-tenths of the carbohydrates.

Other things being equal, foods furnishing nutrients which can be most easily and completely utilized by the body are the most desirable, since they will not bring unnecessary exertion to the various organs. Many kinds of food which in their natural state hold the most valuable nutrients in such form that the digestive juices cannot easily work upon them are so changed by the heat of cooking that they become easily digestible. Thus the importance of proper cooking can hardly be overestimated. Things which please the palate stimulate the flow of the digestive juices; for this reason food should be made appetizing. An attractive diet pleases the esthetic sense; hence refinement in food habits is as desirable as in other phases of our daily life. The sense of comfort and satisfaction produced by even the appearance of food well cooked and served is of indisputable value. Fortunately such satisfaction is within the reach of almost all.

Among people who have the benefits of modern comfort and culture the palate revolts against a very simple and unvaried diet, and for this reason the nutrients are usually supplied from a variety of articles—some of ani-

mal, some of vegetable origin. With a varied diet it is also easier to secure the proper proportions of protein to fats and carbohydrates.

As the habits and conditions of individuals differ, so, too, their needs for nourishment differ, and their food should be adapted to their particular requirements. It has been estimated that an average man at moderately active labor, like a carpenter or mason, should have about 115 grams or 0.25 pound of available protein and sufficient fuel ingredients in addition to make the fuel value of the whole diet 3,400 calories, while a man at sedentary employment would be well nourished with 92 grams or 0.20 pound of available protein and enough fats and carbohydrates in addition to yield 2,700 calories of energy. The demands are, however, variable, increasing or decreasing with increase or decrease of muscular work, or as other needs of the person change. Each person, too, should learn by experience what kinds of food yield him nourishment with the least discomfort, and should avoid those which do not "agree" with him.

Too much food is as bad as too little and occasions a waste of energy and strength in the body as well as a waste of nutritive material. While in the case of some foods as purchased, notably meats, some waste is unavoidable, the pecuniary loss can be diminished, both by buying those kinds in which there is the least waste, and by utilizing more carefully than is ordinarily done portions of what is usually classed as refuse. Much of the waste may be avoided by careful planning so as to provide a comfortable and appetizing meal in sufficient amount, but without excess. If strict economy is necessary, the dearer cuts of meat and the more expensive fruits and vegetables should be avoided. With reasonable care in cooking and serving, a pleasing and varied diet can be furnished at moderate cost. It should not be forgotten that the real cheapness or dearness of a food material depends not only on its market price, but also on the cost of its digestible nutrients. It should always be remembered that "the ideal diet is that combination of foods which, while imposing the least burden on the body, supplies it with exactly sufficient material to meet its wants," and that any disregard of such a standard must inevitably prevent the best development of our powers.

ECONOMICAL USE OF MEAT

UTILIZING THE FAT, BONE AND TRIMMINGS IN MEATS AND THE LEFT-OVER COLD MEATS.

In the percentage of fat present in different kinds and cuts of meat, a greater difference exists than in the percentage of proteids. The lowest percentage of fat shown in the table on page 14 was 8.1 per cent. in the shank of beef; the highest was 32 per cent. in the pork chops. The highest priced cuts, loin and ribs of beef contain 20 to 25 per cent. If the fat of the meat is not eaten at the table, and is not utilized otherwise, a pecuniary loss results. If butter is the fat used in making crusts for meat pies, and in preparing the cheaper cuts, there is little economy involved; the fats from other meat should therefore be saved, as they may be used in place of butter in such cases, as well as in preparing many other foods. The fat from sausage or from the soup kettle, or from a pot roast, which is savory because it has been cooked with vegetables, is particularly acceptable. Sometimes savory vegetables, onion, or sweet herbs are added to fat when it is tried out to give it flavor.

Some illustrations of methods of preparing such cooking fats follow:

TRYING OUT FAT.

A double boiler is the best utensil to use in trying out small portions of fat. There is no danger of burning the fat and the odor is much less noticeable than if it is heated in a dish set directly over the fire.

CLARIFYING FAT.

Excepting where the purpose of clarifying fat is to remove flavors, a good method to follow is to pour boiling water over the fat, to boil thoroughly, and then to set it away to cool. The cold fat may be removed in a solid cake and any impurities clinging to it may be scraped off, as they will be found at the bottom of the layer. By repeating this process two or three times a cake of clean, white fat may be obtained.

A slight burned taste or similar objectionable flavors often can be removed from fat by means of potatoes. After melting the fat, put into it thick slices of raw potato; heat gradually. When the fat ceases to bubble and the potatoes are brown, strain through a cloth placed in a wire strainer.

SAVORY DRIPPINGS.

When rendering the drippings of fat meat, add a small onion (do not cut it), a few leaves of summer savory and thyme, a teaspoonful of salt, and a little pepper. This is enough for a pint of fat. Keep the drippings covered and in a cool place.

USES FOR BONES.

Almost any meat bones can be used in soup making, and if the meat is not all removed from them the soup is better. But some bones, especially the rib bones, if they have have a little meat left on them, can be grilled or roasted into very palatable dishes. The "sparerib" of Southern cooks is made of the rib bones from a roast of pork, and makes a favorite dish when well browned. The braised ribs of beef often served in high-class restaurants are made from the bones cut from rib roasts. In this connection it may be noted that many of the dishes popular in good hotels are made of portions of meat such as are frequently thrown away in private houses, but which, with proper cooking and seasoning, make attractive dishes and give most acceptable variety to the menu. An old recipe for "broiled bones" directs that the bones (beef ribs or sirloin bones on which the meat is not left too thick in any part) be sprinkled with salt and pepper (Cayenne), and broiled over a clear fire until browned. Another example of the use of bones is boiled marrow bone. The bones are cut in convenient lengths, the ends covered with a little piece of dough over which a floured cloth is tied, and cooked in boiling water for two hours. After removing the cloth and dough, the bones are placed upright on toast and served. Prepared as above, the bones may also be baked in a deep dish. Marrow is sometimes removed from bones after cooking, seasoned and served on toast.

Trimmings from meat may be utilized in various "made dishes" of which examples will be given farther on, or they can always be put to good use in the soup kettle. It is surprising how many economies may be practiced in such ways and also in the table use of left-over portions of cooked meat if attention is given to the matter. Many of the recipes given in this bulletin involve the use of such left-overs. Others will suggest themselves or may be found in all the usual cookery books.

METHODS OF EXTENDING THE FLAVOR OF MEAT.

Common household methods of extending the meat flavor through a considerable quantity of material which would otherwise be lacking in distinctive taste are to serve the meat with dumplings, generally in the dish with it, to combine the meat with crusts, as in meat pies or meat rolls, or to serve the meat on toast and biscuits. Borders of rice, hominy, or mashed potatoes are examples of the same principles applied in different ways. By serving some preparation of flour, rice, hominy, or other food rich in starch with the meat we get a dish which in itself approaches nearer to the balanced ration than meat alone and one in which the meat flavor is extended through a large amount of the material.

Throughout the bulletin the measurements given in the recipes call for a level spoonful or a level cupful, as the case may be.

USE OF DUMPLINGS AND SIMILAR PREPARATIONS.

A number of recipes for meat dishes made with dumplings and similar preparations follow:

MEAT STEW WITH DUMPLINGS.

STEW.

5 pounds of a cheaper cut of beef.
4 cups of potatoes cut into small pieces.
½ onion, chopped.
2-3 cups each of turnips and carrots cut into ½-inch cubes.
¼ cup of flour.
Salt and pepper.

Cut the meat into small pieces, removing the fat; try out the fat and brown the meat in it. When well browned, cover with boiling water; boil for five minutes and then cook in a lower temperature until the meat is done. If tender, this will require about three hours on the stove or five hours in the fireless cooker. Add carrots, turnips, onions, pepper and salt during the last hour of cooking, and the potatoes fifteen minutes before serving. Thicken with the flour diluted with cold water. Serve with dumplings (see below). If this dish is made in the fireless cooker, the mixture must be reheated when the vegetables are put in. Such a stew may also be made of mutton. If veal or pork is used the vegetables may be omitted or simply a little onion used. Sometimes for variety the browning of the meat is dispensed with. When white meat, such as chicken, veal or fresh pork is used, the gravy is often made rich with cream or milk thickened with flour. The numerous minor additions which may be introduced give the great variety of such stews found in cook books.

DUMPLINGS.

2 cups flour.
4 teaspoonfuls baking powder.
2 teaspoonfuls butter.
2-3 cup milk or a little more if needed.
½ teaspoonful saft.

Mix and sift the dry ingredients. Work in the butter with the tips of fingers, add milk gradually, roll out to a thickness of one-half inch and cut with biscuit cutter. In some countries it is customary to season the dumplings themselves with herbs, etc., or to stuff them with bread crumbs fried in butter instead of depending upon the gravy to season them.

A good way to cook dumplings is to put them in a buttered steamer over a kettle of hot water. They should cook from twelve to fifteen minutes. If it is necessary to cook them with the stew, enough liquid should be removed so that they may be placed upon the meat and vegetables.

Sometimes the dough is baked and served as biscuits over which the stew is poured. If the stew is made with chicken or veal it is generally termed a fricasse.

RAGOUT OF MUTTON WITH FARINA BALLS.

1½ pounds neck of mutton, cut into small pieces.
1 tablespoonful butter.
1 tablespoonful flour.
1 onion.
1 carrot.
½ can peas.
2 cups hot water.
1 teaspoonful salt.
¼ teaspoonful pepper.
1 bay leaf.
Sprig parsley.
1 clove.

FARINA BALLS.

¼ cup farina.
1 cup of milk.
¼ teaspoonful salt.
⅛ teaspoonful pepper.
Onion juice.
Yolk 1 egg.

Put butter in frying pan. When melted add flour and brown. Add carrot and onion, cut in dice. Remove vegetables and add meat, searing well. To meat and vegetables add hot water and seasonings. Put in a suitable kettle, cover and simmer two hours. Add peas ten minutes before serving in a dish with farina balls made as follows:

Cook farina and milk in double boiler one hour. Add seasoning and well-beaten yolk. Stir well and cool. When cold roll into balls. Dip in egg and crumbs and fry in deep fat. Rice may be used in a similar way.

MEAT PIES AND SIMILAR DISHES.

Meat pies represent another method of combining flour with meat. They are ordinarily baked in a fairly deep dish the sides of which may or may not be lined with dough. The cooked meat, cut into small pieces, is put into the dish, sometimes with small pieces of vegetables, a gravy is poured over the meat, the dish is covered with a layer of dough, and then baked. Most commonly the dough is like that used for soda or cream-of-tartar biscuit, but sometimes shortened pastry dough, such as is made for pies, is used. This is especially the case in the fancy individual dishes usually called patties. Occasionally the pie is covered with a potato crust in which case the meat is put directly into the dish without lining the latter. Stewed beef, veal and chicken are probably most frequently used in pies, but any kind of meat may be used, or several kinds in combination. Pork pies are favorite dishes in many rural regions, especially at hog-killing time, and when well made are excellent.

If pies are made from raw meat and vegetables longer cooking is needed than otherwise, and in such cases it is well to cover the dish with a plate, cook until the pie is nearly done, then remove the plate, add the crust, and return to the oven until the crust is lightly browned. Many cooks insist on piercing holes in the top crust of a meat pie directly it is taken from the oven.

TWELVE O'CLOCK PIE.

This is made with shoulder of mutton, boiled with carrot and onion, then cut up, mixed with potatoes separately boiled and cut up, and put into a baking dish. The crust is made by mixing smoothly mashed potatoes to which a tablespoonful of shortening has been added, with enough flour and water to make them roll out easily. A pie made of a pound of meat will require 5 or 6 small boiled potatoes, a cupful of mashed potatoes, and 8 to 10 tablespoonfuls of flour, and should be baked about twenty minutes in a hot oven. Salt, pepper and other seasoning, as onion and carrot, may be added to taste. A teaspoonful of baking powder makes the crust lighter

MEAT AND TOMATO PIE.

This dish presents an excellent way of using up small quantities of either cold beef or cold mutton. If fresh tomatoes are used, peel and slice them; if canned, drain off the liquid. Place a layer of tomatoes in a baking dish, then a layer of sliced meat, and over the two dredge flour, pepper and salt; repeat until the dish is nearly full, then put in an extra layer of tomatoes and cover the whole with a layer of pastry or of bread or cracker crumbs. When the quantity of meat is small, it may be "helped out" by boiled potatoes or other suitable vegetables. A few oysters or mushrooms improve the flavor, especially when beef is used. The pie will need to be baked from half an hour to an hour according to its size and the heat of the oven.

MEAT AND PASTRY ROLLS.

Small quantities of cold ham, chicken or other meat may be utilized for these. The meat should be chopped fine, well seasoned, mixed with enough savory fat or butter to make it "shape," and formed into rolls about the size of a finger. A short dough (made, say, of a pint of flour, 2 tablespoonfuls of lard, 1 teaspoonful of baking powder, salt and milk enough to mix) should be rolled thin, cut into strips and folded about the meat rolls, care being taken to keep the shape regular. The rolls should be baked in a quick oven until they are a delicate brown color and served hot.

MEAT TURNOVERS.

Almost any kind of chopped meat may be used in these, and, if the quantity on hand is small, may be mixed with potato or cooked rice. This filling should be seasoned to taste with salt and pepper, onion, or whatever is relished, and laid on pieces of short biscuit dough rolled thin and cut into circles about the size of an ordinary saucer. The edges of the dough should be moistened with the white of egg, the dough then folded over the meat, and its edges pinched closely together. If desired, the tops of the turnovers may be brushed over with yolk of egg before they are placed in the oven. About half an hour's baking in a hot oven is required. Serving with a brown sauce increases the flavor and moistens the crust.

MEAT WITH MACARONI AND OTHER STARCHY MATERIALS.

Macaroni cooked with chopped ham, hash made of meat and potatoes or meat and rice, meat croquettes—made of meat and some starchy materials like bread crumbs, cracker dust, or rice—are other familiar examples of meat combined with starchy materials. Pilaf, a dish very common in the Orient and well known in the United States, is of this character and easily made. When there is soup or soup stock on hand it can be well used in the pilaf.

TURKISH PILAF.

½ cup of rice.
¾ cup of tomatoes stewed and strained.
1 cup stock or broth.
3 tablespoonfuls of butter.

Cook the rice and tomatoes with the stock in a double boiler until the rice is tender, removing the cover after the rice is cooked if there is too much liquid. Add the butter and stir it in with a fork to prevent the rice from being broken. A little catsup or Chili sauce with water enough to make three-quarters of a cup may be substituted for the tomatoes. This may be served as a border with meat, or served separately in the place of a vegetable, or may make the main dish at a meal, as it is savory and reasonably nutritious.

MEAT CAKES.

1 pound chopped veal.
¼ pound soaked bread crumbs.
2 tablespoonfuls savory fat or butter.
1 teaspoonful chopped onion.
1½ teaspoonfuls salt.
Dash of pepper.

Mix all the ingredients except the butter or fat and shape into small round cakes. Melt the fat in a baking pan and brown the cakes in it, first one side and then the other. Either cooked or raw veal may be used. In the case of raw meat the pan should be covered so that the heat may be retained to soften the meat.

STEW FROM COLD ROAST.

This dish provides a good way of using up the remnants of a roast, either of beef or mutton. The meat should be freed from fat, gristle and bones, cut into small pieces, slightly salted, and put into a kettle with water enough to nearly cover it. It should simmer until almost ready to break in pieces, when onions and raw potatoes, peeled and quartered, should be added. A little soup stock may also be added if available. Cook until the potatoes are done, then thicken the liquor or gravy with flour. The stew may be attractively served on slices of crisp toast.

MEAT WITH BEANS.

Dry beans are very rich in protein, the percentage being fully as large as that in meat. Dry beans and other similar legumes are usually cooked in water, which they absorbed, and so are diluted before serving; on the other hand, meats by the ordinary methods of cooking are usually deprived of some of the water originally present—facts which are often overlooked in discussing the matter. Nevertheless, when beans are served with meat the dish is almost as rich in protein as if it consisted entirely of meat.

Pork and beans is such a well-known dish that recipes are not needed. Some cooks use a piece of corned mutton or a piece of corned beef in place of salt or corned pork or bacon or use butter or olive oil in preparing this dish.

In the Southern States, where cowpeas are a common crop, they are cooked in the same way as dried beans. Cowpeas baked with salt pork or bacon make an excellent dish resembling pork and beans, but of distinctive flavor. Cowpeas boiled with ham or with bacon are also well-known and palatable dishes.

Recipes are here given for some less common meat and bean dishes.

MEXICAN BEEF.

The Mexicans have a dish known as "Chili con carne" (meat with Chili pepper), the ingredients for which one would doubtless have difficulty in obtaining except in the Southwestern United States. However, a good substitute for it may be made with the foods available in all parts of the country. The Mexican recipe is as follows:

Remove the seeds from two Chili peppers, soak the pods in a pint of warm water until they are soft, scrape the pulp from the skin and add to the water. Cut two pounds of beef into small pieces and brown in butter or drippings. Add a clove of garlic and the Chili water Cook until the meat is tender, renewing the water if necessary. Thicken the sauce with flour. Serve with Mexican beans either mixed with the meat or used as a border.

In the absence of the Chili peppers, water and Cayenne pepper may be used, and onions may be substituted for garlic. For the Mexican beans, red kidney beans either fresh or canned make a good substitute. If the canned beans are used they should be drained and heated in a little savory fat or butter. The liquid may be added to the meat while it is cooking. If the dried beans are used they should be soaked until soft, then cooked in water until tender and rather day, a little butter or dripping and salt being used for seasoning or gravy. White or dried Lima beans may be used in a similar way.

HARICOT OF MUTTON.

2 tablespoonfuls of chopped onions.
1½ pounds of lean mutton or lamb cut into 2-inch pieces.
2 tablespoonfuls of butter or drippings.
2 cups of water, and salt and pepper.

Fry the onions in the butter, add the meat and brown; cover with water and cook until the meat is tender. Serve with a border

of Lima beans, seasoned with salt, pepper, butter, and a little chopped parsley. Fresh, canned, dried, or evaporated Lima beans may be used in making this dish.

ROAST PORK WITH COWPEAS.

For this dish a leg of young pork should be selected. With a sharp knife make a deep cut in the knuckle and fill the opening with sage, pepper, salt, and chopped onion. When the roast is half done scar the skin, but do not cut deeper than the outer rind. When the meat is nearly cooked pour off the excess of fat and add a quart of *white* cowpeas which have been previously par-boiled or "hulled" and cook slowly until quite done and the meat is brown. Apple sauce may be served with this dish.

MEAT SALADS.

Whether meat salads are economical or not depends upon the way in which the materials are utilized. If in chicken salad, for example, only the white meat of chickens especially bought for the purpose and only the inside stems of expensive celery are used, it can hardly be cheaper than plain chicken. But, if portions of meat left over from a previous serving are mixed with celery grown at home, they certainly make an economical dish, and one very acceptable to most persons. Cold roast pork or tender veal—in fact, any white meat—can be utilized in the same way. Apples cut into cubes may be substituted for part of the celery; many cooks consider that with the apple the salad takes the dressing better than with the celery alone. Many also prefer to marinate (i. e., mix with a little oil and vinegar) the meat and celery or celery and apples before putting in the final dressing, which may be either mayonnaise or a good boiled dressing.

MEAT WITH EGGS.

Occasionally eggs are combined with meat, making very nutritious dishes. Whether this is an economy or not, of course, depends on the comparative cost of eggs and meat.

In general, it may be said that eggs are cheaper food than meat when a dozen costs less than 1½ pounds of meat, for a dozen eggs weigh about 1½ pounds and the proportions of protein and fat which they contain are not far different from the proportions of these nutrients in the average cut of meat. When eggs are 30 cents a dozen they compare favorably with round of beef at 20 cents a pound.

Such common dishes as ham and eggs, bacon or salt pork and eggs, and omelette with minced ham or other meat are familiar to all cooks.

ROAST BEEF WITH YORKSHIRE PUDDING.

The beef is roasted as usual and the pudding made as follows:

YORKSHIRE PUDDING.

3 eggs.	1 cupful flour.
1 pint milk.	1 teaspoonful salt.

Beat the eggs until very light, then add the milk. Pour the mixture over the flour, add the salt, and beat well. Bake in hissing hot gem pans or in an ordinary baking pan for 45 minutes and baste with drippings from the beef. If gem pans are used they should be placed on a dripping pan to protect the floor of the oven from the fat. Many cooks prefer to bake Yorkshire pudding in the pan with the meat; in this case the roast should be placed on a rack and the pudding batter poured on the pan under it.

CORNED-BEEF HASH WITH POACHED EGGS.

A dish popular with many persons is corned-beef hash with poached eggs on top of the hash. A slice of toast is sometimes used under the hash. This suggests a way of utilizing the small amount of corned-beef hash which would otherwise be insufficient for a meal.

Housekeepers occasionally use up odd bits of other meat in a similar way, chopping and seasoning them and then warming and serving in individual baking cups with a poached or shirred egg on each.

HAM AND POACHED EGGS WITH CREAM SAUCE.

A more elaborate dish of meat and eggs is made by placing a piece of thinly sliced boiled ham on a round of buttered toast, a poached egg on the ham, and covering with a highly seasoned cream or a Hollandaise sauce. A slice of tongue may be used instead of the ham. If preferred, a well-seasoned and rather thick tomato sauce or curry sauce may be used.

STUFFING OR FORCEMEAT.

Another popular way to extend the flavor of meat over a large amount of food is by the use of stuffing or forcemeat (a synonym more common in England than in the United States). As it is impossible to introduce much stuffing into some pieces of meat even if the meat is cut to make a pocket for it, it is well to prepare more than can be put into the meat and to cook the remainder in the pan beside the meat. Some cooks cover the extra stuffing with buttered paper while it is cooking and baste it at intervals.

Some recipes for meat dishes of this character follow, and others will be found in cook books:

MOCK DUCK.

Mock duck is made by placing on a round steak a stuffing of bread crumb well seasoned with chopped onions, butter, chopped suet or dripping, salt, pepper, and a little sage, if the flavor is relished. The steak is then rolled around the stuffing and tied with a string in several places. If the steak seems tough, the roll is steamed or stewed until tender before roasting in the oven until brown. Or it may be cooked in a casserole or other covered dish, in which case a cupful or more of water or soup-stock should be poured around the meat. Mock duck is excellent served with currant or other acid jelly.

MOCK WILD DUCK.

1 flank steak, or	½ cup cracker crumbs.
1½ pounds round steak cut ½ inch thick.	Salt, pepper, and powdered thyme, sage and savory.
2 lamb kidneys.	2 tablespoonfuls flour.
¼ cup butter or drippings.	1 tablespoonful sugar.
1 tablespoonful minced onion.	3 cupfuls water or stock.

Trim the kidneys of all fat, cords, and veins. Cut into small pieces and spread evenly over one side of the steak together with the crumbs, onion, and seasoning. Roll and tie with a cord. Brown the roll in fat, then remove and make a gravy by heating the flour in the fat and adding three cupfuls of stock or water and the sugar. Put the meat into the gravy and cook slowly until tender in a covered baking dish, a steamer, or a fireless cooker. If steamed or cooked in a fireless cooker, the roll should be browned in the oven before serving.

VEAL OR BEEF BIRDS.

A popular dish known as veal or beef birds or by a variety of special names is made by taking small pieces of meat, each just large enough for an individual serving, and preparing them in the same way as the mock duck is prepared.

Sometimes variety is introduced by seasoning the stuffing with chopped olives or tomatoes. Many cooks prepare their "birds" by browning in a little fat, then adding a little water, covering closely and simmering until tender.

UTILIZING THE CHEAPER CUTS OF MEAT IN PALATABLE DISHES.

When the housekeeper attempts to reduce her meat bill by using the less expensive cuts, she commonly has two difficulties to contend with—toughness and lack of

flavor. It has been shown how prolonged cooking softens the connective tissues of the meat. Pounding the meat and chopping it are also employed with tough cuts, as they help to break the muscle fibers. As for flavor, the natural flavor of meat even in the least desirable cuts may be developed by careful cooking, notably by browning the surface, and other flavors may be given by the addition of vegetables and seasoning with condiments of various kinds.

Methods of preparing inexpensive meat dishes will be discussed and practical directions for them will be given in the following sections. As often happens, two or three methods may be illustrated by the same dish, but the attempt has been made to group the recipes according to their most salient feature.

PROLONGED COOKING AT LOW HEAT.

Meat may be cooked in water in a number of ways without being allowed to reach the boiling point. With the ordinary kitchen range this is accomplished by cooking on the cooler part of the stove rather than on the hottest part, directly over the fire. Experience with a gas stove, particularly if it has a small burner known as a "simmerer," usually enables the cook to maintain temperatures which are high enough to sterilize the meat if it has become accidentally contaminated in any way and to make it tender without hardening the fibers. The double boiler would seem to be a neglected utensil for this purpose. Its contents can easily be kept up to a temperature of 200° F., and nothing will burn. Another method is by means of the fireless cooker. In this a high temperature can be maintained for a long time without the application of fresh heat. Still another method is by means of a closely covered baking dish. Earthenware dishes of this kind suitable for serving foods as well as for cooking are known as casseroles. For cooking purposes a baking dish covered with a plate or a bean jar covered with a saucer may be substituted. The Aladdin oven has long been popular for the purpose of preserving temperatures which are near the boiling point and yet do not reach it. It is a thoroughly insulated oven which may be heated either by a kerosene lamp or a gas jet.

In this connection directions are given for using some of the toughest and least promising pieces of meat.

STEWED SHIN OF BEEF.

4 pounds of shin of beef.
1 medium-sized onion.
1 whole clove and a small bay leaf.
1 sprig of parsley.
1½ tablespoonfuls of flour.
1 small slice of carrot.
½ tablespoonful of salt.
½ teaspoonful of pepper.
2 quarts of boiling water.
1½ tablespoonfuls of butter or savory drippings.

Have the butcher cut the bone in several pieces. Put all the ingredients but the flour and butter into a stewpan and bring to a boil. Set the pan where the liquid will just simmer for six hours, or after boiling for five or ten minutes, put all into the fireless cooker for eight or nine hours. with the butter, flour, and one-half cupful of the clear soup from which the fat has been removed, make a brown sauce; to this add the meat and the marrow removed from the bone. Heat and serve. The remainder of the liquid in which the meat has been cooked may be used for soup.

BOILED BEEF WITH HORSERADISH SAUCE.

Plain boiled beef may be served with horseradish sauce, and makes a palatable dish. A little chopped parsley sprinkled over the meat when served is considered an improvement by many persons. For the sake of variety the meat may be browned like pot roast before serving.

SCOTCH BROTH.

3 pounds mutton.
2 tablespoonfuls of pearl barley.
2 tablespoonfuls of minced onion.
2 tablespoonfuls of minced turnip.
2 tablespoonfuls of minced carrot.
2 tablespoonfuls of minced celery.
2 tablespoonfuls of salt.
1 teasponful of pepper.
1 tablespoonful of minced parsley.
3 quarts cold water.

Remove the bones and all the fat from the mutton, cut the meat into small pieces and put it into a stew pan with the water, chopped vegetables, barley, and all the seasoning excepting the parsley. It will be found convenient to tie the bones in a piece of thin white cloth before adding them to the other ingredients. Bring the stew to a boil, quickly skim it and allow it to simmer for three hours, thicken with the flour, and add the chopped parsley.

STUFFED HEART.

Wash the heart thoroughly inside and out, stuff with the following mixture, and sew up the opening: One cup broken bread dipped in fat and browned in the oven, 1 chopped onion and salt and pepper to taste.

Cover the heart with water and simmer until tender or boil ten minutes and set in the fireless cooker for six or eight hours. Remove from the water about one-half hour before serving. Dredge with flour, pepper and salt, or sprinkle with crumbs and bake until brown.

BRAISED BEEF, POT ROAST, AND BEEF A LA MODE

The above names are given to dishes made from the less tender cuts of meat. They vary little either in composition or method of preparation. In all cases the meat is browned on the outside to increase the flavor and then cooked in a small amount of water in a closely covered kettle or other receptacle until tender. The flavor of the dish is secured by browning the meat and by the addition of the seasoning vegetables. Many recipes suggest that the vegetables be removed before serving and the liquid be thickened. As the vegetables are usually extremely well seasoned by means of the browned fat and the extracts of the meat, it seems unfortunate not to serve them.

Of course, the kind, quality, and shape of the meat all play their part in the matter. Extra time is needed for meats with a good deal of sinew and tough fibers such as the tough steaks, shank cuts, etc.; and naturally a filet of beef, or a steak from a prime cut, will take less time than a thick piece from the shin. Such dishes require more time and perhaps more skill in their preparation and may involve more expense for fuel than the more costly cuts, which like chops or tender steaks may be quickly cooked, but to the epicure, as well as to the average man, they are palatable when rightly prepared.

BEAN-POT ROAST.

3 pounds mutton (shoulder), or
3 pounds round, or chuck steak.
¼ cup sliced onion.
1 cup carrot cut into small pieces.
1 cup potatoes cut into small pieces.

Cover the meat with boiling water. Place the cover on the bean pot and let the meat cook in a moderate oven for two hours; then add the vegetables cut in half-inch cubes, with 2 teaspoonfuls salt; cook until the vegetables are tender, which will require about one hour; then serve, pouring a sauce over the meat, made from 1 cup of the liquid in which the meat was cooked, thickened with 2 tablespoonfuls of flour.

HUNGARIAN GOULASH.

2 pounds top round of beef.
A little flour.
2 ounces salt pork.
2 cups tomatoes.
1 stalk celery.
1 onion.
2 bay leaves.
6 whole cloves.
6 peppercorns.
1 blade mace.

Cut the beef into 2-inch pieces and sprinkle with flour; fry the salt pork until light brown; add the beef and cook slowly for about thirty-five minutes, stirring occasionally. Cover with water and sim-

mer about two hours, and season with salt and paprika.

From the vegetables and spices a sauce is made as follows: Cook in sufficient water to cover for twenty minutes; then rub through a sieve, and add to some of the stock in which the meat was cooked. Thicken with flour, using 2 tablespoonfuls (moistened with cold water) to each cup of liquid, and season with salt and paprika.

Serve the meat on a platter with the sauce poured over it. Potatoes, carrots, and green peppers cooked until tender, and cut into small pieces or narrow strips, are usually sprinkled over the dish when served, and noodles may be arranged in a border upon the platter.

Goulash is a Hungarian dish which has come to be a favorite in the United States.

CASSEROLE COOKERY

A casserole is a heavy earthenware dish with a cover. A substitute for it can easily be improvised by using any heavy earthenware dish with a heavy plate for the cover. A casserole presentable enough in appearance to be put on the table serves the double purpose of baking and serving dish.

A suitable cut of beef or veal, and it may well be one of the cheaper cut, as the long, slow cooking insures tenderness, may be cooked in a casserole.

Poultry and other meats besides beef or veal can be cooked in this manner. Chicken cooked in a casserole, which is a favorite and expensive dish in good hotels and restaurants, may be easily prepared in the home, and casserole cookery is to be recommended for a tough chicken.

The heat must be moderate and the cooking occupy a long time. Hurried cooking in a casserole is out of the question. If care is taken in this particular, and suitable seasonings are used, few who know anything of cooking should go astray.

Chopped meat also may be cooked in a casserole and this utensil is particularly useful for the purpose, because the food is served in the same dish in which it is cooked and may easily be kept hot, a point which is important with chopped meats, which usually cool rapidly.

CASSEROLE ROAST.

3 or 4 pounds of round or rump of beef.
A slice of salt pork.
A few peppercorns.
One-fourth each of a carrot, a turnip, an onion, and a head of celery cut into small pieces.

Try out the pork. Brown the meat on both sides in the fat. Put in a casserole with the vegetables around it, add 2 cupfuls of water or stock. Cover and cook in a hot oven three hours, basting occasionally. A sauce or gravy can be made with water, flour, and some of the juice left in the casserole.

CASSEROLE OR ITALIAN HASH.

Boil one-fourth pound of macaroni, drain and put into a buttered casserole, add a little butter and grated cheese. Push the macaroni to the sides of the dish and fill the center with chopped cooked meat seasoned to suit the taste of the family. A little sausage gives a good flavor to this dish. Place in the oven until hot throughout, and serve.

A very good modification of this is made by using raw instead of cooked meat. For this, one-half pound of round steak is sufficient for a family of six. This should be cut into small pieces, browned, and cooked until tender in water with the onions and other seasonings. An hour before the cooking is complete, add one-half can of tomatoes. Before serving, the meat may be mixed with the sauce, and the whole is poured over the macaroni.

MEAT COOKED WITH VINEGAR.

Dishes of similar sort as regard cooking, but in which vinegar is used to give flavor as well as to soften the meat and make it tender, are the following:

SOUR BEEF.

Take a piece of beef from the rump or the lower round, cover with vinegar or with half-and-half mixture of vinegar and water, add sliced onion, bay leaves, and a few mixed whole spices and salt. Allow to stand a week in winter or three or four days in summer; turn once a day and keep covered. When ready to cook, brown the meat in fat, using an enameled iron pan, strain the liquid over it and cook until tender; thicken the gravy with flour or ginger snaps (which may be broken up first), strain it, and pour over the sliced meat. Some cooks add cream.

SOUR BEEFSTEAK.

Round steak may be cooked in water in which there is a little vinegar, or if the time is sufficient, it may be soaked for a few hours in vinegar and water and then cooked in a casserole or in some similar way.

POUNDED MEAT.

Pounding meat before cooking is an old-fashioned method of making it tender, but while it has the advantage of breaking down the tough tissues it has the disadvantage of being likely to drive out the juices and with them the flavor. A very good way of escaping this difficulty is pounding flour into the meat; this catches and retains the juices. Below are given the recipes for two palatable dishes in which this is done:

FARMER STEW.

Pound flour into both sides of a round steak, using as much as the meat will take up. This may be done with a meat pounder or with the edge of a heavy plate. Fry in drippings, butter, or other fat in a Scotch bowl, or if more convenient in an ordinary iron kettle or a frying pan; then add water enough to cover it. Cover the dish very tightly so that the steam cannot escape, and allow the meat to simmer for two hours or until it is tender. One advantage of this dish is that ordinarily it is ready to serve when the meat is done as the gravy is already thickened. However, if a large amount of fat is used in the frying, the gravy may not be thick enough and must be blended with flour.

SPANISH BEEFSTEAK.

Take a piece of round steak weighing 2 pounds and about an inch thick; pound until thin, season with salt and Cayenne pepper, cover with a layer of bacon or salt pork, cut into thin slices, roll and tie with a cord. Pour around it half a cupful of milk and half a cupful of water. Place in a covered baking dish and cook two hours, basting occasionally.

CHOPPED MEAT.

Chopping meat is one of the principal methods of making tough and inexpensive meat tender, i. e., dividing it finely and thus cutting the connective tissue into small bits. Such meats have another advantage in that they may be cooked quickly and economically.

In broiling chopped meat the fact should be kept in mind that there is no reason why it should not be cooked like the best and most expensive tenderloin. The only reason that ever existed for difference in treatment was the toughness of the connective tissue, and this feature has been overcome by the chopping. The ideal to be reached in broiling steak is to sear the surface very quickly, so that the juices which contain the greater part of the flavoring of the meat shall be kept in, and then to allow the heat to penetrate to the inside until the whole mass is cooked to the taste of the family. To pass the point where the meat ceases to be puffy and juicy and becomes flat and hard is very undesirable, as the palatability is then lost. Exactly the same ideal should be kept in mind in broiling chopped meat. If this were always done, hard, compact, tasteless balls or cakes of meat would be served less often. To begin with, the broiler should be even more carefully greased than for a whole steak. This makes it possible to form the balls or cakes of chopped meat with very little pressure without running the risk of having them pulled to pieces by adhering to the wires of the broiler. They should be heated on both sides even more quickly than the steak, because the chopping has provided more ways of escape for the juice, and these openings should be sealed as soon as possible.

The interior should be cooked to the taste of the family just as the steak is.

In regard to broiling it may incidentally be noted that housekeepers often make themselves unnecessary work when broiling under gas by allowing the juice from steaks or meat balls to drop into the large pan under the rack. A smaller pan set in the larger one may be made to catch all the juice and fat and is much easier to wash. It serves also to economize the gravy.

Chopped raw meat of almost any kind can be very quickly made into a savory dish by cooking it with water and milk for a short time, then thickening with butter and flour, and adding different seasonings as relish, either pepper and salt alone, or onion juice, celery, or tomato. Such a dish may be made to "go further" by serving it on toast or with a border of rice or in some similar combination.

TOUGH PORTIONS OF PORTERHOUSE STEAK.

Before speaking of the cooking of the cuts that lack tenderness throughout, it may be well to refer to the fact that the flank end of the porterhouse is to be classed with the toughest of cuts and with those which, when cooked alone, are with difficulty made tender even by long heating. Mock duck, which is commonly made out of flank steak, can be rendered tender enough to be palatable only by long steaming or cooking in water and yet people generally broil this part of the steak with the tenderloin and expect it to be eaten. The fact is that to broil this part of the porterhouse steak is not good management. It is much more profitable to put it into the soup kettle or to make it into a stew. In families where most of the members are away during the day the latter is a good plan, for the end of a steak makes a good stew for two or three people. This may be seasoned with vegetables left from dinner., or two or three olives cut up in gravy will give a very good flavor; or a few drops of some one of the bottled meat sauces, if the flavor is relished, or a little Chili sauce may be added to the stew. But if the tough end of a porterhouse is needed with the rest, a good plan is to put it through a meat grinder, make it into balls, and broil it with the tender portions. Each member of the family can be served with a piece of the tenderloin and a meat ball. If the chopped meat is seasoned with a little onion juice, grated lemon rind, or chopped parsley, a good flavor is imparted to the gravy.

HAMBURG STEAK.

This name is commonly given to inexpensive cuts of beef chopped, seasoned a little, shaped into small balls or into one large thin cake, and quickly broiled in the way that a tender steak would be. Owing to the quick cooking, much of the natural flavor of the meat is developed and retained. The fact should be kept in mind that Hamburg steak must be made from fresh, well-ground meat. It is much safer to chop the meat at home, as chopped meat spoils very quickly. Much depends, too, upon browning it sufficiently to bring out the flavors. Many cooks think that Hamburg steak is improved if the meat is mixed with milk before it is cooked.

In some parts of the country, and particularly in some of the Southern States, two kinds of beef are on sale. One is imported from other parts of the country and is of higher price. The other, known locally as "native beef," is sometimes lacking in flavor and is fat and is usually tougher. Southern native beef such as raised in Florida is almost invariably, however, of extremely good flavor, due presumably to the feed or other conditions under which it is raised. By chopping such meat and cooking it as Hamburg steak, a dish almost as palatable as the best cuts of the more expensive beef may be obtained. In such cases, however, it is desirable, because of the low percentage of fat, to add suet or butter to the meat. The reason for this is that in the cooking the water of the juice when unprotected by fat evaporates too quickly and leaves the meat dry. This may be prevented by adding egg as well as fat, for the albumen of the egg hardens quickly and tends to keep in the juices. The proportion should be 1 egg to 1½ pounds of meat.

SAVORY ROLLS.

Savory rolls in great variety are made out of chopped meat either with or without egg. The variety is secured by the flavoring materials used and by the sauces with which the baked rolls are served. A few recipes will be given below. While these definite directions are given it should be remembered that a few general principles borne in mind make recipes unnecessary and make it possible to utilize whatever may happen to be on hand. Appetizing rolls are made with beef and pork mixed. The proportion varies from two parts of beef and one of pork to two of pork and one of beef. The rolls are always improved by laying thin slices of salt pork or bacon over them, which keep the surface moistened with fat during the roasting. These slices should be scored on the edge, so that they will not curl up in cooking. The necessity for the salt pork is greater when the chopped meat is chiefly beef than when it is largely pork or veal. Bread crumbs or bread moistened in water can always be added, as it helps to make the dish go further. When onions, green peppers, or other vegetables are used, they should always be thoroughly cooked in fat before being put in the roll, for usually they do not cook sufficiently in the length of time it takes to cook the meat. Sausage makes a good addition to the roll, but it is usually cheaper to use unseasoned pork meat with the addition of a little sage.

CANNELON OF BEEF.

This dish is prepared by making chopped beef into a roll and baking it wrapped in a buttered paper, a method designed to keep in the steam and so insure a moist, tender dish. The paper must be removed before serving. The roll should be basted occasionally with butter and water or drippings and water. In preparing the roll an egg may be added for each pound and a half of meat, and chopped parsley, onion juice, lemon peel, or finely chopped green peppers make good seasoning. A thickened gravy may be made from the drippings, the liquid used being either water or tomato juice.

Strips of pork laid on the roll may be substituted for the buttered paper and basting.

FILIPINO BEEF.

1 pound round of beef.	1 cup of soft stale bread crumbs.
½ pound lean fresh pork.	2 cups of stewed tomatoes.
1 small onion.	2 slices of bacon.
1 green pepper.	2 tablespoonfuls of butter.
1 teaspoonful of salt.	4 tablespoonfuls of flour.
1 egg.	

Remove the seeds from the pepper and put it through the meat grinder with the meats and the onion. Add crumbs, egg and salt. Make into a roll, place in a shallow baking dish, pour the strained tomatoes around it, put the bacon on top, and bake forty minutes, basting with the tomatoes. Thicken the gravy with the flour cooked in the butter. A little seasoning such as a bit of bay leaf, a clove, and a small piece of onion, improves the tomato sauce. As the pepper and onion are not likely to be cooked as soon as the meat, it is well to fry them in a little fat before adding to the other ingredients.

This dish will serve 6 to 8 people. When the meat is 20 cents a pound and every other item is valued at usual town market prices, the dish costs about 50 cents. If the meat costs only 10 cents per pound and the vegetables from the garden are used the initial cost of the dish will be small. Since no vegetable except potatoes or rice need be served with this dish, it may be said to answer the purpose of both meat and vegetable.

MOCK RABBIT.

½ pound round steak, and	3 slices of bread moistened with
1 pound sausage;	water.
or	1 egg.
1 pound round steak, and	1 onion.
½ pound sausage meat.	¼ pound salt pork.
	Pepper and salt.

Chop the meat. Chop the onion and cook (but do not brown) it in the fat tried out of a small portion of the pork. Add the bread and cook a few minutes. When this is cool, mix all the ingredients and form into a long round roll. The surface can easily be made

smooth if the hand is wet with cold water. Lay the remaining pork, cut in thin slices, on top, and bake forty minutes in a hot oven. The sausage may be omitted if desired and other seasoning used.

VEAL LOAF.

3 pounds veal.	3 eggs, well beaten.
1 pound salt pork.	¼ teaspoonful pepper.
6 soda crackers rolled fine.	½ teaspoonful salt.

Chop the meat mixed with the other ingredients, shape, and bake three hours, basting occasionally with pork fat. Use one-fourth cup of fat for this purpose. If the roll is pierced occasionally, the fat will penetrate more effectively. Veal loaf may also be cooked in bread pans. Some persons cook the veal before chopping.

DEVELOPING AND IMPROVING FLAVOR OF MEAT.

The typical meat flavors are very palatable to most persons, even when they are constantly tasted, and consequently the better cuts of meat in which they are well developed can be cooked and served without attention being paid especially to flavor. Careful cooking aids in developing the natural flavor of some of the cheaper cuts, and such a result is to be sought wherever it is possible. Browning also brings out flavors agreeable to most palates. Aside from these two ways of increasing the flavor of the meat itself there are countless ways of adding flavor to otherwise rather tasteless meats. The flavors may be added in preparing the meat for cooking, as in various seasoned dishes already described, or they may be supplied to cooked meat in the form of sauces.

RETAINING NATURAL FLAVOR.

As has already been pointed out, it is extremely difficult to retain the flavor-giving extractives in a piece of meat so tough as to require prolonged cooking. It is sometimes partially accomplished by first searing the exterior of the meat and thus preventing the escape of the juices. Another device, illustrated by the following recipe, is to let them escape into the gravy which is served with the meat itself. A similar principle is applied when roasts are basted with their own juice.

ROUND STEAK ON BISCUITS.

Cut round steak into pieces about one-half inch square, cover with water and cook it at a temperature just below the boiling point until it is tender, or boil for five minutes, and while still hot put into the fireless cooker and leave it for five hours. Thicken the gravy with flour mixed with water, allowing 2 level tablespoonfuls to a cup of water. Pour the meat and gravy over split baking powder biscuits so baked that they have a large amount of crust.

FLAVOR OF BROWNED MEAT OR FAT.

Next to the unchanged flavor of the meat itself comes the flavor which is secured by browning the meat with fat. The outside slices of roast meat have this browned flavor in marked degree. Except in the case of roasts, browning for flavor is usually accomplished by heating the meat in a frying pan in fat which has been tried out of pork, or in suet or butter. Care should be taken that the fat is not scorched. The chief reason for the bad opinion in which fried food is held by many is that it almost always means eating burned fat. When fat is heated too high it splits up into fatty acids and glycerin, and from the glycerin is formed a substance (acrolein) which has a very irritating effect upon the mucous membrane. All will recall that the fumes of scorched fat makes the eyes water. It is not surprising that such a substance, if taken into the stomach, should cause digestive disturbance. Fat in itself is a very valuable food, and the objection to fried foods because they may be fat seems illogical. If they supply burned fat there is a good reason for suspicion. Many housekeepers cook bacon in the oven on a wire broiler over a pan and believe it more wholesome than fried bacon. The reason, of course, is that thus cooked in the oven there is less chance for the bacon becoming impregnated with the burned fat. Where fried salt pork is much used good cooks know that it must not be cooked over a very hot fire, even if they have never heard of the chemistry of burned fat. The recipe for bean-pot roast and other similar recipes may be varied by browning the meat or part of it before covering with water. This results in keeping some of the natural flavoring within the meat itself and allowing less to go into the gravy. The flavor of veal can be very greatly improved in this way.

The following old-fashioned dishes made with pork owe their savoriness chiefly to the flavor of browned fat or meat:

SALT PORK WITH MILK GRAVY.

Cut salt or cured pork into thin slices. If very salt, cover with hot water and allow it to stand for ten minutes. Score the rind of the slices and fry slowly until they are a golden brown. Make a milk gravy by heating flour in the fat that has been tried out, allowing 2 tablespoonfuls of fat and 2 tablespoonfuls of flour to each cup of milk. This is a good way to use skim milk, which is as rich in protein as whole milk. The pork and milk gravy served with boiled or baked potatoes makes a cheap and simple meal, but one that most people like very much. Bacon is often used in place of salt pork in making this dish.

FRIED SALT PORK WITH SALT CODFISH OR "SALT-FISH DINNER."

½pound salt pork.	2 cups of milk (skim milk will do).
1 pound codfish.	
4 tablespoonfuls flour.	A speck of salt.

Cut the codfish into strips; soak in lukewarm water and then cook in water until tender, but do not allow the water to come to the boiling point except for a very short time, as prolonged boiling may make it tough. Cut the pork into one-fourth inch slices and cut several gashes in each piece. Fry very slowly until golden brown and remove, pouring off the fat. Out of 4 tablespoonfuls of the fat, the flour and the milk make a white sauce. Dish up the codfish with pieces of pork around it and serve with boiled potatoes and beets. Some persons serve the pork and the fat from it in a gravyboat so it can be added as relished.

FLAVORING VEGETABLES, HERBS, SPICES, ETC.

Many flavorings are used in meat dishes, some of which are familiar to all cooks—onions, carrots, turnips and garlic being perhaps the most widely known. Butter, too, may be regarded as one of the most common seasonings, and, of course, makes the dish richer. Meat extract is also used for flavoring many meat dishes and other foods, as are also, though less commonly, similar extracts made from clams or other "sea food." The following lish includes these with various others, a number of which it is convenient to keep always on hand: Onions, carrots, green peppers, parsnips, turnips, tomatoes, fresh, canned or dried; celery tops and parsley, either fresh or dried; sage, savory, thyme, sweet marjoram, bay leaf, garlic, lemon rind, vinegar, capers, pickles, olives, currant jelly, curry powder, cloves, pepper corns, celery seed, meat extract, Chili sauce, pepper sauce, or some similar hot or sharp sauce, and some kind of good commercial meat sauce. Some hints regarding the use of such flavorings follow:

Flavor of Fried Vegetables.—Most of the stews, soups, braised meats and pot roasts are very much improved if the flavoring vegetables which they contain, such as carrots, turnips, onions, celery or green peppers are fried in a little fat before being cooked

with the meat. This need not complicate the preparation of the meat or increase the number of utensils used, for the meat itself is usually seared over in fat, and the vegetables can be cooked in the same fat before the browning of the meat.

Onion Juice.—Cook books usually say that onion juice should be extracted by cutting an onion in two and rubbing the cut surface against a grater. Considering how hard it is to wash a grater, this method has its drawbacks. Small amounts of juice may be obtained in the following simpler way: Peel the onion and extract a few drops of juice by pressing one side with the dull edge of a knife.

Green Peppers.—The flavor of green peppers gives an acceptable variety. The seed should always be removed. The peppers should be chopped and added to chopped meat or other meat dishes. Meat mixed with bread crumbs may be baked in the pepper shells and the stuffed peppers served as a separate dish.

Parsley.—It is easy to raise parsley by growing it in a pot in the kitchen window and thus to have it always on hand fresh, or the leaves may be kept for a long time if sealed up in a fruit jar and stored in a cool place. Parsley, mint and celery tops may all be dried, rubbed into fine bits and kept in air-tight jars. Recipes usually say to chop fresh parsley with a sharp knife on a board. But a board is a hard thing to wash and a plate serves the purpose quite as well.

Bay Leaf.—Bay leaf is one of the best and at the same time one of the most abused flavors. In small quantities it gives a very pleasant flavor to soups and gravies, but in large quantities it gives a rank, resin-like taste. Remember that half of a bay leaf is the allowance for 3 quarts of soup stock. This will indicate how small a quantity should be used for the portion of gravy usually served at a meal. With this precaution in mind, bay leaf may be recommended as a flavoring for many sauces, particularly tomato sauce.

A Kitchen Bouquet.—A "bouquet" such as is often referred to in recipes may be made as follows: A sprig each of parsley, savory and thyme, one small leaf of sage and a bay leaf. This will flavor 1 gallon of soup when cooked in it for an houi and should not remain in it longer.

Horseradish.—Horseradish, like mustard, is more often served with meat than used to flavor it during cooking. A very palatable sauce, especially good with boiled beef, is made by adding grated horseradish and a little vinegar to a little whipped cream, or as follows: Thicken milk with cracker crumbs by heating them together in a double boiler, using 3 tablespoonfuls of cracker crumbs tu 1½ cups of milk. Add one-third of a cup of grated horseradish, 3 tablespoonfuls of butter and ½ teaspoonful of salt; or thicken with butter and flour some of the water in which the meat was boiled, add a generous quantity (1 or 2 tablespoonfuls) of grated horseradish, boil a short time and serve. This recipe is the most usual in German homes where the sauce is a favorite.

Acid Flavoring.—Vinegar, lemon juice and sour jelly, like currant, are often used to flavor the thick gravies which are a part uf meat stew or which are served with it. Vinegar is an old-fashioned relish which was often added to bacon or salt pork and greens, pork and beans, corned beef and cabbage and similar dishes. These flavors combine well with that of brown flour, but not with onions or other vegetables of strong flavor. The idea that vinegar used in small quantities is unwholesome seems to be without foundation.

Pickles.—Chopped pickles are sometimes added to the gravy served with boiled mutton. They are cheaper than capers and serve somewhat the same purpose. Chopped pickles are also very commonly used in sauces for fish and in many others to give a distinctive flavor.

Olives.—Chopped olives also make a welcome variety in meat sauce, and are not expensive if they are bought in bulk. They will not spoil if a little olive oil is poured on the top of the liquor in which they are kept. This liquor should always completely cover them.

Chili Sauce, Commercial Meat Sauces, etc.—Recipes often may be varied by the addition of a little Chili sauce, tomato catsup, or a commercial meat sauce. These may be called emergency meat flavors and used when it is not convenient to prepare other kinds of gravies.

Sausage.—A little sausage or chopped ham may be used in chopped beef.

Curry Powder.—This mixture of spices which apparently originated in India, but which is now a common commercial product everywhere, is a favorite flavoring for veal, lamb or poultry. The precaution mentioned in connection with bay leaves, however, should be observed. A small amount gives a good flavor. It is usually used to season the thick sauces with which meats are served or in which they are allowed to simmer. While the term "curry" is usually employed to describe a particular mixture of spices made up for the trade, it has another meaning. The word "curry" or "curried" are sometimes used to describe highly seasoned dishes of meat, eggs or vegetables prepared by methods that have come from India or other parts of the East.

INDIA CURRY.

1½ pounds veal.	2 onions or less.
½ cup of butter or drippings.	½ tablespoonful curry or less.

Brown meat either without fat or with very little and cut into small pieces.

Fry the onions in the butter, remove them, add the meat and curry powder. Cover the meat with boiling water and cook until tender. Serve with a border of rice. This dish is so savory that it can be made to go a long way by serving with a large amount of rice. The two onions and one-half tablespoonful of curry powder are the largest amount to be used. Many persons prefer less uf each.

In preparing the rice for this dish perhaps no better method can be given than that in an earlier bulletin of this series.*

"Wash 1 cupful of rice in several waters, rubbing the grains between the hands to remove all the dirt. Put the washed rice in a stewpan with 2½ cupfuls of water and 1 teaspoonful of salt. Cover and place where the water will boil. Cook for twenty minutes, being careful not to let it burn. At the end of this time put the stewpan on a tripod or ring and cover the rice with a fold of cheesecloth. Let it continue to cook in this manner an hour, then turn into a hot vegetable dish. The rice will be tender, dry and sweet, and each grain will separate. During the whole process of cooking the rice must not be stirred. If a tablespoonful of butter is cut up and scattered over the rice when it has cooked twenty minutes the dish will be very much improved."

The butter is not necessary when the rice is served with India curry, but may be included in dishes where less fat is used.

CURRY OF VEAL.

2 tablespoonfuls butter or drippings.	1 pint milk.
	1 tablespoonful flour.
1½ pounds veal.	1 teaspoonful curry powder.
½ union, chopped.	Salt and pepper.

Fry the onions in the butter or drippings, remove and fry the veal until it is brown. Transfer the meat to the double boiler, cover with milk and cook until the meat is tender. Add the curry powder a short time before the meat is done and thicken the milk with flour before serving.

SAUCES.

The art of preparing savory gravies and sauces is more important in connection with the serving of the cheaper meats than in connection with the cooking of the more expensive.

There are a few general principles underlying the making of all sauces or gravies whether the liquid used is water, milk, stock, tomato juice, or some combination of these. For ordinary gravy 2 level tablespoonfuls of flour or 1½ tablespoonfuls of cornstarch or arrow root is sufficient to thicken a cupful of liquid. This is true excepting when the flour is browned. In this case about one-half tablespoonful more should be allowed, for

*U. S. Dept. Agr., Farmers Bul. 256, p. 38.

browned flour does not thicken so well as unbrowned. The fat used may be butter or the drippings from the meat, the allowance being 2 tablespoonfuls to a cup of liquid.

The easiest way to mix the ingredients is to heat the fat, add the flour, and cook until the mixture ceases to bubble, and then to add the liquid. This is a quick method, and by using it there is little danger of getting a lumpy gravy. Many persons, however, think it is not a wholesome method and prefer the old-fashioned one of thickening the gravy by means of flour mixed with a little cold water. The latter method is, of course, not practicable for brown gravies.

Considering the large amount of discussion about the digestibility of fried food and of gravies made by heating flour in fat, a few words on the subject at this point may not be out of order. It is difficult to see how heating the fat before adding the flour can be unwholesome, unless the cook is unskilled enough to heat the fat so high that it begins to scorch. Overheated fat, as has already been pointed out, contains an acrid irritating substance called "acrolein," which may be readily considered to be unwholesome. It is without doubt the production of this body by overheating which has given fried food its bad name.

Several ways of varying the flavor of gravies and sauces were suggested in the preceding section. One other should be especially mentioned here.

The flavor of browned flour.—The good flavor of browned flour is often overlooked. If flour is cooked in fat until it is a dark brown color a distinctive and very agreeable flavor is obtained. This flavor combines very well with that of currant jelly, and a little jelly added to a brown gravy is a great improvement. The flavor of this should not be combined with that of onions or other highly flavored vegetables. A recipe for a dish which is made with brown sauce follows.

MOCK VENISON

Cut cold mutton into thin slices and heat in a brown sauce made according to the following proportions:

2 tablespoonfuls butter.	2 tablespoonfuls flour.
1 tablespoonful of bottled meat sauce (whichever is preferred).	1 tablespoonful red currant jelly.
	1 cupful water or stock.

Brown the flour in the butter, add the water or stock slowly, and keep stirring. Then add the jelly and meat sauce and let the mixture boil up well.

FISH AS FOOD

VALUE AND USE OF FISH.

As ordinarily used, the term fish includes, besides the fish proper, many other water animals, as oysters, clams and other mollusks; lobsters, crawfish, crabs and shrimps, and turtle and terripin. The term "sea food" is often used to cover the whole group, or, more particularly, salt-water food products as distinguished from those of fresh water.

Fish in one form or another is almost universally recognized as an important food material, and enters to some extent into the diet of very many if not the majority of American families. Few, however, have any adequate conception of the great importance of the fisheries of the United States and of the immense amount of nutritive material which is every year taken from the salt and fresh waters of this country.

From recent data collected by the United States Fish Commission it appears that more than 528,000,000 pounds of fish, crustaceans, etc., are annually taken from the waters of the New England States; over 819,000,000 pounds from the Middle Atlantic States; over 106,000,000 from the South Atlantic States; 113,000,000 from the Gulf States; 217,000,000 from the Pacific coast; 96,000,000 from the Mississippi River and its tributaries, and 166,000,000 pounds from Alaska. The products of the fisheries of the Great Lakes exceed 113,000,000 pounds annually, and of the minor interior waters 5,000,000 pounds. In addition, thousands of pounds of fish are annually caught by sportsmen, but statistics of the amount are not available. In the case of the coast sections the statistics given above include only the coast fisheries. The interior fisheries of Vermont are included with those of New England, the fisheries of New York and Pennsylvania on the Great Lakes with those of the Middle Atlantic States, and the fisheries of the east coast of Florida with those of the Gulf States. The data for the Great Lakes embrace only those States not having coast fisheries, but include the fisheries of the Ohio River for Ohio, Indiana and Illinois. The figures for the interior States are confined to States not having coast or Great Lake fisheries. In all sections the data represent the products as they leave the hands of the fishermen, except that in the case of Alaska the figures include salmon after being canned or otherwise prepared for the market. In considering such products as clams, scallops and oysters the weight of the edible portion only has been taken into account.

The total weight of the fish products of the United States as they leave the hands of the fishermen is about 2,169,000,000 pounds, representing in round numbers as the value of the catch $58,000,000. By the processes of canning, salting, smoking, and otherwise preserving, the value of the fish is very much increased.

Of the very large quantity of fish annually placed on the American market, the greater part is consumed at home, although a portion is prepared in various ways for export.

The preference for fresh-water or salt-water fish is a matter of individual taste. Both are, so far as known, equally wholesome. Indeed, it may be said that in general the preference for one kind of sea food or another is quite largely a matter of circumstances. It is noticeable that many kinds of fish which are known to be good are seldom eaten. Among others may be mentioned the whiting, or silver hake, and the sea robin. The latter are taken in enormous quantities in certain regions. This prejudice against certain fish is largely local; for instance, skates are eaten on the western coast of the United States, but until recently they were regarded as of no value in the East. A few years ago sturgeon and eel were not generally eaten. Today sturgeon is much prized, and in regions where it was formerly worthless commands a high price. Many persons have a prejudice against frogs' legs, while others consider them a great delicacy. In the United States they are now very commonly eaten, and frog raising for the market is more or less of an industry. It is doubtful

if Americans ever eat any portion except the legs of frogs, yet in many regions of Europe the bodies are also used. In Cuba and other localities squid tentacles are eaten, and are undoubtedly palatable when well prepared. An interesting change of opinion regarding the use of a sea product may be noted in the case of abalone, a large mollusk abundant on the California cost, which was formerly disregarded as a food product by Americans, but which, it is said, owing to its use by the Chinese, has become known and is relished.

CONDITIONS WHICH AFFECT THE MARKET VALUE OF FISH.

The market value of fish is affected by various conditions. Among these are the locality from which they come, the season in which they are taken, and the food on which they have grown. In general, it may be said that fish from clear, cold, or deep water are regarded as preferable to those from shallow or warm water, while fish taken in waters with a rocky or sandy bottom are preferable to those from water with a muddy bottom. Some fish, for instance shad, are at their best during the spawning season, while others should not be eaten during this period. Those fish which feed on small crustacea and the other forms of animal and vegetable life, constituting their natural food, arepreferable to those living upon sewage and other matter which may contaminate the waters.

The mode of capture also affects the market value. Fish caught by the gills and allowed to die in the water by slow degrees, as is the case where gill nets are used, undergo decomposition very readily and are inferior for food. Fish are often landed alive and allowed to die slowly. This custom is not only inhumane, but lessens the value of the fish. It has been found that fish killed immediately after catching remain firm and bear shipment better than those allowed to die slowly. The quality of the fish is often injured by improper handling in the fishing boats before placing on the market. Improvements in transportation facilities and in other lines have made it possible to bring fish to market from distant fishing grounds in good condition.

Fresh-water and salt-water fish alike are offered for sale as taken from the water, and preserved in a number of ways. In some cases preservation is only to insure transportation to remote points in good condition. Low temperature is the means most commonly employed for this purpose. By taking advantage of the recent improvements in apparatus and methods of chilling and freezing, fish may be shipped long distances and kept a long time in good condition.

The preservation of meat or fish by methods of cold storage has developed very greatly within recent years and has grown to be a very important industry. The process depends for its success quite largely upon the fact that the activity of micro-organisms, which cause putrefactive and other changes in food products, is lessened by cold. In addition to micro-organisms which are almost inevitably present, being found everywhere—in the air, in water, etc.—fish, like other meats, normally contain ferments which cause changes in composition and flavor comparable in some ways with those caused by micro-organisms, though they differ in important respects. From recent investigations along these lines, the conclusion was reached that when meat is stored at the freezing point of water (32° F.) the activity of micro-organisms is checked, but the action of ferments normally present in the meat still continues, and it ripens, though it does not decay. Such stored meat was regarded as especially suited for roasting or broiling, though not as good as fresh meat for boiling. On the other hand, the conclusion was reached that fish cannot be satisfactorily preserved at 32° F., since this temperature is not sufficient to hinder the action of the ferments present in the fish flesh, though it checks the action of micro-organisms. The ferments acting upon the tissues in which they occur produce bodies of unpleasant flavor and the fish becomes unpalatable, though it is not in any sense decayed. To successfully hinder the action of the ferments a temperature lower that 32° F. is needed. These facts are in accord with the common practice of shipping fish frozen.

It is stated on good authority that in commercial practice 25° F. is regarded as the proper temperature for storing fish which has been previously frozen. For dried fish the proper temperature is 25° F., for fresh fish 25 to 30° F., for oysters 33 to 40° F., for oysters in the shell 40°., and for oytsers in the tub 35° F. Oysters should not be frozen. It is claimed that oysters may be safely kept for six weeks at a temperature of 40° F., and an instance is recorded in which they were kept ten weeks at this temperature for experimental purposes.

According to the practice of a successful firm dealing in frozen fish, the fish, as they are unloaded from the boats, are sorted and graded as to size and quality, then placed in galvanized iron pans about 2 feet long, covered with loosely fitting lids, and frozen by keeping them twenty-four hours at a temperature often as low as 16° below zero. The fish are removed from the pans in a solid cake and packed in tiers in the storehouse and marketed frozen. It is said that they may be thus preserved indefinitely, though as a rule frozen fish are only kept six to eight months, being frozen in the spring, when the supply is abundant, and sold in the winter or whenever fresh fish cannot be readily obtained. Such frozen fish are commonly shipped in barrels packed with broken ice in such a manner that the water formed by the melting ice may readily escape.

The flavor of oysters is affected more or less by the locality in which they have grown, those from certain regions being regarded as of very superior quality. The season of the year affects the market value of oysters, although it is noticeable that as methods of transportation and preservation improve, the oyster season becomes longer. This may also be said of lobsters, crabs, etc. Extended investigations, including the conditions affecting the growth and food value of oysters, their parasites and diseases, etc., have been carried on by the New Jersey Experiment Stations. These investigations have shown that oysters rapidly deteriorate when removed from the water, through the fermentative action of bacteria; and that oysters in spawn deteriorate more rapidly than at any other season at the same temperature. However, oysters which are ready to spawn are considered especially palatable if cooked soon after removal from the sea bed.

PREPARING FISH FOR MARKET.

Fish are sold either "round," i. e., whole, or dressed. Sometimes only the entrails are removed. Often, however, especially when dressed for cooking, the head, fins, and, less frequently, the bones are removed. This entails a considerable loss in weight as well as of nutritive material. It has been assumed that in dressing fish the following percentages are lost: Large-mouthed black bass, sea bass, cisco, kingfish, mullet, white perch, pickerel, pike, tomcod, weakfish and whitefish, each 17.5 per cent.; small-mouthed black bass, eel, Spanish mackerel, porgy and turbot, each, 13.5 per cent.; butterfish, 12.5

per cent.; shad, 11 per cent., and brook trout, 16.5 per cent. More recent figures for loss in weight in dressing are as follows: Bullhead, 50 per cent.; buffalo-fish and lake sturgeon, 40 per cent.; carp and sucker, 35 per cent.; fresh-water sheepshead, 23 per cent.; grass pike, black bass, white bass, yellow perch and salmon, 15 per cent., and eels, 10 per cent.

Large quantities of fish are dried, salted and smoked, the processes being employed alone or in combination. These methods insure preservation, but at the same time modify the flavor. Several fish products are also prepared by one or more of these processes. Caviar, which may be cited as an example, is usually prepared from sturgeon roe by salting. The methods of salting and packing vary somewhat and give rise to a number of varieties. Although formerly prepared almost exclusively in Russia, caviar is now made to a large extent in the United States. In methods of drying fish the Chinese are very expert, producing, among other goods, dried oysters, which are said to be palatable and of good quality. Dried fish and fish products are also important in the diet of the Japanese.

When fish are salted and cured there is a considerable loss in weight, due to removal of the entrails, drying, etc. Codfish lose 60 per cent. in preparation for market. If the market-dried fish is boned there is a further loss of 20 per cent. The loss in weight of pollock from the round to the market-dried fish is 60 per cent.; haddock, 62 per cent.; hake, 56 per cent., and cusk, 51 per cent.

The Scandinavians make a number of fish products in which the fish is allowed to ferment, the methods followed being in a way comparable with those employed in the manufacture of sauerkraut. In Java the natives are very partial to fish which has undergone fermentation, sometimes apparently putrefactive and resulting in a product which would be considered entirely unfit for food from a western standpoint.

The canning industry has been enormously developed in recent years and thousands of pounds of fish, oysters, lobsters, etc., are annually preserved in this way. In canning, the fish or other material is heated (the air being sometimes exhausted also) to destroy micro-organisms, and sealed to prevent access of air, which would introduce micro-organisms as well as oxygen. Thus the canned material is preserved from oxidation and decomposition. The processes of canning have been much improved, so that the original flavor is largely retained, while the goods may be kept for an indefinite period. Fish, as well as meat, is usually canned in its own juice or cooked in some form, though sardines and some other fishes are commonly preserved in oil.

Various kinds of fish extract, clam juice, etc., are offered for sale. These are similar in form to meat extract. There are also a number of fish pastes and similar products—anchovy paste, for instance—which are used as relishes or condiments.

Oysters and other shellfish are placed on the market alive in the shell or are removed from the shell and kept in good condition by chilling or other means. Oysters in the shell are usually transported in barrels or sacks. Shipment is made to far inland points in refrigerator cars and to Europe in the cold-storage chambers of vessels. Large quantities of shellfish are also canned. Oysters are often sold as they are taken from the salt water. However, the practice of "freshening," "fattening," or "floating" is very widespread—that is, oysters are placed in fresh or brackish water for a short period. They become plump in appearance and have a different flavor from those taken directly from salt water. Care should be taken that the oysters are grown and fattened in water which is not contaminated by sewage.

Lobsters, crabs and other crustacea are usually sold alive. Sometimes they are boiled before they are placed on the market. Large quantities of lobsters, shrimps and crabs are canned.

Turtle and terrapin are usually marketed alive. Turtle soup, however, is canned in large quantities. Frogs are marketed alive or dressed, and may be eaten at all seasons, but are in the best condition in the fall or winter. It is said that Minnesota is the center of the frog industry in the United States, the catch for a year being about 5,000,000 frogs, or not far from 500,000 dozen pairs of frogs' legs, the annual value of the frog business being upward of $100,000.

NUTRITIVE VALUE OF FISH.

COMPOSITION OF FISH.

Fish contain the same kind of nutrients as other food materials. In general it may be said that food (fish, meat, cereals, vegetables, etc.) serves a twofold purpose: It supplies the body with material for building and repairing its tissues and fluids, and furnishes it with fuel for maintaining body temperature and for supplying the energy necessary for muscular work.

In a way the body is like a machine, with food for its source of motive power. The body differs from a machine, however, in that the fuel, i. e., food, is used to build it as well as supply it with energy. Further, if the body is supplied with more food than is needed, the excess can be stored as reserve material, usually in the form of fat. In the furnace, fuel is burned quickly, yielding heat and certain chemical products—carbon dioxid, water vapor and nitrogen. In the body the combustion takes place much more slowly, but in general the final products are the same. The combustion of nitrogen is, however, not so complete as in a furnace. Due allowance is made for this fact in calculations involving the question of the energy which food will furnish.

Food consists of an edible portion and refuse, i. e., bones of fish and meat, shells of oysters, bran of wheat, etc. Although foods are so different in appearance, chemical analysis shows that they are all made up of a comparatively small number of chemical compounds. These are water and the so-called nutrients, protein or nitrogenous materials, fat, carbohydrates and ash or mineral matter. Familiar examples of protein are lean of fish and meat, white of egg, casein of milk (and cheese) and gluten of wheat. Fat is found in fat fish and meat, in lard, fat of milk (butter), and oils, such as olive oil. Starches, sugars and woody fiber or cellulose form the bulk of the carbohydrates. Certain carbohydrates are found in meat and fish, although the amount is not large. The protein, fats and carbohydrates are all organic substances—that is, they can be burned with the formation of various gases, chiefly carbon dioxid and water, leaving no solid residue. The mineral matters will not burn, and are left behind when organic matter is ignited. By analysis the nutrients have been found to be made up of a comparatively small number of chemical elements in varying combinations. These are nitrogen, carbon, oxygen, hydrogen, phosphorus, sulphur, calcium, magnesium, sodium, potassium, silicon, chlorin, fluorin and iron. Doubtless no single nutrient contains all these elements. The body tissues and fluids contain nitrogen, and hence protein, which alone supplies nitrogen to the body, is a necessary factor in food. All the

nutrients except mineral matter contain carbon, oxygen and hydrogen and can supply them to the body. Protein, fat and carbohydrates are all sources of energy.

The value of a food as a source of material for building and repairing the body is shown by its chemical composition—that is, by the amount of digestible nutrients which it contains. Some other means are necessary to show its value as a source of energy. It is known that all energy may be measured in terms of heat. In order to have some measure for expressing the amount of heat the calorie is taken as a unit. Roughly speaking, this is the amount of heat required to raise the temperature of 1 pound of water 4° F. One pound of starch would; if burned and all the heat utilized, raise 1,900 pounds of water 4° in temperature; or would raise 5 gallons of water from the freezing point to the boiling point, but would not cause it to boil.

The number of calories which different foods will supply may be determined by burning them in an apparatus called a calorimeter, or by taking the sum of the calories which it is calculated the protein, fat and carbohydrates making up the food would furnish. It has been found by experiment that the fuel value of a pound of protein as ordinarily burned in the body is 1,860 calories; the fuel value of a pound of carbohydrates is the same, while that of a found of fat is 2.25 times as great.

The value of a food is usually judged by several different standards. Thus it must be digestible and palatable, furnish the nutrients needed by the system in proper amounts, and be reasonably cheap.

The relative nutritive value of any food may be learned by comparing its composition and energy value with similar data for other foods. Table 1 shows the composition of a number of food fishes, fresh and preserved in a variety of ways; oysters, claims and other mollusks; lobsters, shrimps, crawfish and crabs; turtle and terrapin and frogs' legs. For purposes of comparison the analyses of a number of kinds of meat, vegetables and other common food materials, are included.

In several cases the analysis of fish, whole and dressed, is given. Usually the composition of the dressed fish was computed from that of whole fish with the aid of the figures for loss of weight in dressing for market.

COMPOSITION OF FISH, MOLLUSKS, CRUSTACEANS, ETC.

Kind of Food Material.	Refuse (bone, skin, etc.)	Salt.	Water.	Protein by Factor (N×6.25).	Fat.	Carbohydrates.	Ash or Mineral Matter.	Total Nutrients.	Fuel Value per Pound.
FRESH FISH.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Calories
Alewife, whole	49.5	....	37.6	9.8	2.4	....	0.8	13.0	277
Bass, large-mouthed black, dressed	46.7	....	41.9	10.3	.5	....	.6	11.4	209
Bass, large-mouthed black, whole	56.0	....	34.6	8.5	.4	....	.5	9.4	172
Bass, small-mouthed black, dressed	46.4	....	40.1	11.7	1.3	....	.7	13.7	263
Bass, small-mouthed black, whole	53.6	....	34.7	10.1	1.1	....	.6	11.8	227
Bass, sea, dressed	46.8	....	42.2	10.5	.2	....	.7	11.4	200
Bass, sea, whole	56.1	....	34.8	8.7	.2	....	.6	9.5	168
Bass, striped, dressed	51.2	....	37.4	8.8	2.2	....	.5	11.5	249
Blackfish, dressed	55.7	....	35.0	8.4	.5	....	.5	9.4	172
Bluefish, dressed	48.6	....	40.3	10.0	.6	....	.7	11.3	204
Butterfish, dressed	34.6	....	45.8	11.8	7.2	....	.7	19.7	503
Butterfish, whole	42.8	....	40.1	10.3	6.3	....	.6	17.2	410
Carp (European analysis)	37.1	....	48.4	....	.7	....	.9	14.5	263
Cod, dressed	29.9	....	58.5	11.1	0.2	....	0.8	12.1	209
Cod, steaks	9.2	....	72.4	17.0	.5	....	1.0	18.5	327
Cusk, dressed	40.3	....	49.0	10.1	.1	....	.5	10.7	186
Eel, salt-water, dressed	20.2	....	57.2	14.8	7.2	....	.8	22.8	558
Flounder, common, dressed	57.0	....	35.8	6.4	.3	....	.6	7.3	127
Flounder, winter, dressed	56.2	....	37.0	6.3	.2	....	.5	7.0	122
Hake, dressed	52.2	....	39.5	7.3	.3	....	.5	8.1	145
Haddock, dressed	51.0	....	40.0	8.4	.2	....	.6	9.2	159
Halibut, dressed	17.7	....	61.9	15.3	4.4	....	.9	20.6	454
Herring, whole	42.6	....	41.7	11.2	3.9	....	.9	16.0	363
Mackerel, dressed	40.7	....	43.7	11.6	3.5	....	.7	15.8	354
Mackerel, Spanish, dressed	24.4	....	51.4	16.3	7.2	....	1.2	24.7	585
Mackerel, Spanish, whole	34.6	....	44.5	14.1	6.2	....	1.0	21.3	508
Mullet, dressed	49.0	....	38.2	9.9	2.4	....	.6	12.9	277
Mullet, whole	57.9	....	31.5	8.2	2.0	....	.5	8.9	231
Perch, white, dressed	54.6	....	34.4	8.8	1.8	....	.5	11.1	231
Perch, white, whole	62.5	....	28.4	7.3	1.5	....	.4	9.2	195
Perch, yellow, dressed	35.1	....	50.7	12.8	.7	....	.9	14.4	259
Pickerel, dressed	35.9	....	51.2	12.0	.2	....	.7	12.9	227
Pickerel, whole	47.1	....	42.2	9.9	.2	....	.6	10.7	186
Pollock, dressed	28.5	....	54.3	15.4	.6	....	1.1	17.1	304
Pompano, whole	45.5	....	39.5	10.3	4.3	....	.5	15.1	358
Porgy, dressed	53.7	....	34.6	8.6	2.4	....	.7	11.7	254
Porgy, whole	60.0	....	29.9	7.4	2.1	....	.6	10.1	218
Red grouper, dressed	55.9	....	35.0	8.5	.2	....	.5	9.2	163
Red snapper, dressed	45.3	....	43.7	10.6	.3	....	.7	11.6	204
Salmon, California (sections)	10.3	....	57.9	16.7	14.8	....	.9	32.4	903
Salmon, Maine, dressed	23.8	....	51.2	15.0	9.5	....	.9	25.4	658
Shad, dressed	43.9	....	39.6	10.6	5.4	....	.8	16.8	408
Shad, whole	50.1	....	35.2	9.4	4.8	....	.7	14.9	363
Shad, roe	....	....	71.2	23.5	3.8	....	1.5	28.8	581
Smelt, whole	41.9	....	46.1	10.1	1.0	....	1.0	12.1	222
Sturgeon, dressed	14.4	....	67.4	15.1	1.6	....	1.2	17.9	340
Tomcod, dressed	51.4	....	39.6	8.4	.3	....	.5	9.2	163
Tomcod, whole	59.9	....	32.7	6.9	.2	....	.4	7.5	132
Trout, brook, dressed	37.9	....	48.4	11.9	1.3	....	.7	13.9	268
Trout, brook, whole	48.1	....	40.4	9.9	1.1	....	.6	11.6	222
Trout, lake, dressed	37.5	....	44.4	11.0	6.2	....	.7	17.9	449
Turbot, dressed	39.5	....	43.1	8.9	8.7	....	.8	18.4	513
Turbot, whole	47.7	....	37.3	7.7	7.5	....	.7	15.9	445
Weakfish, dressed	41.7	....	46.1	10.4	1.3	....	.7	12.4	240
Weakfish, whole	51.9	....	38.0	8.6	1.1	....	.6	10.3	200
Whitefish, dressed	43.6	....	39.4	12.8	3.6	....	.9	17.3	376
Whitefish, whole	53.5	....	32.5	10.6	3.0	....	.7	14.3	313
General average of fresh fish as sold	41.6	....	44.6	10.9	2.4	....	.7	14.0	295
PRESERVED FISH.									
Mackerel, No. 1, salted	19.7	8.3	34.8	13.9	21.2	....	2.1	37.2	1,107
Cod, salted and dried	24.9	17.3	40.2	19.0	.4	....	1.2	20.6	363
Cod, boneless codfish, salted and dried	....	21.5	54.4	26.3	.3	....	1.7	28.3	490
Caviar	....	....	38.1	30.0	19.7	7.6	*4.6	61.9	1,479
Herring, salted, smoked and dried	44.4	6.5	19.2	20.5	8.8	....	.9	30.2	726

*Including salt.

COMPOSITION OF FISH, MOLLUSKS, CRUSTACEANS, ETC.—(Continued).

Kind of Food Material.	Refuse (bone, skin, etc.)	Salt.	Water.	Protein by Factor (N×6.25).	Fat.	Carbo-hydrates.	Ash or Mineral Matter.	Total Nutrients.	Fuel Value per Pound.
PRESERVED FISH.—(Continued).	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Calories
Haddock, salted, smoked and dried	32.2	1.4	49.2	15.8	.1	....	1.0	16.9	290
Halibut, salted, smoked and dried	7.0	12.0	46.0	19.3	14.0	....	1.9	35.2	916
Sardines, canned	5.0	....	53.6	23.7	12.1	....	5.3	41.1	916
Salmon, canned	14.2	....	56.8	19.5	7.5	....	*2.0	29.0	658
Mackerel, canned	....	1.9	68.2	19.6	8.7	....	1.3	29.6	708
Mackerel, salt, canned	19.7	8.3	34.8	13.9	21.2	....	2.1	37.2	1,107
Tunny, canned	....	....	72.7	21.7	4.1	....	1.7	27.5	558
Haddock, smoked, cooked, canned	....	5.6	68.7	22.3	2.3	....	1.6	26.2	499
MOLLUSKS.									
Oysters, solids	....	....	88.3	6.0	1.3	3.3	1.1	11.7	222
Oysters, in shell	81.4	....	16.1	1.2	.2	.7	.4	2.5	41
Oysters, canned	....	....	83.4	8.8	2.4	3.9	1.5	16.6	327
Scallops	....	....	80.3	14.8	.1	3.4	1.4	19.7	336
Long clams, in shell	41.9	....	49.9	5.0	.6	1.1	1.5	8.2	136
Long clams, canned	....	....	84.5	9.0	1.3	2.9	2.3	15.5	268
Round clams, removed from shell	....	....	80.8	10.6	1.1	5.2	2.3	19.2	331
Round clams, in shell	67.5	....	28.0	2.1	.1	1.4	.9	4.5	68
Round clams, canned	....	....	82.9	10.5	.8	3.0	2.8	17.1	277
Mussels	46.7	....	44.9	4.6	.6	2.2	1.0	8.4	150
General average of mollusks (exclusive of canned)	59.4	....	34.7	3.2	.4	1.4	.9	5.9	99
CRUSTACEANS.									
Lobster, in shell	61.7	....	30.7	5.9	.7	.2	.8	7.6	141
Lobster, canned	....	....	77.8	18.1	1.1	.5	2.5	22.2	381
Crawfish, in shell	86.6	....	10.9	2.1	.1	.1	.2	2.5	45
Crabs, in shell	52.4	....	36.7	7.9	.9	.6	1.5	10.9	191
Crabs, canned	....	....	80.0	15.8	1.5	.7	2.0	20.0	358
Shrimp, canned	....	....	70.8	25.4	1.0	.2	2.6	29.2	503
Fresh abalone	....	....	72.8	22.2	.3	3.3	1.4	27.2	501
Canned abalone, flesh	....	....	73.2	21.7	.1	3.7	1.3	26.8	489
Canned abalone, liquid in can	....	....	93.8	4.4	.1	.2	1.5	6.2	93
Dried abalone	....	....	39.7	36.0	.5	20.9	2.9	60.3	1,079
General average of crustaceans (exclusive of canned and dried).	50.2	....	37.8	9.5	.5	1.0	1.0	12.0	220
TERRAPIN, TURTLE, ETC.									
Terrapin, in shell	73.4	....	18.3	5.2	.9	....	.2	6.3	132
Green turtle, in shell	76.0	....	19.2	4.7	.1	....	.3	5.1	91
Average of turtle and terrapin	75.6	....	18.8	4.9	.5	....	.3	5.7	111
Frogs' legs	32.0	....	56.9	10.5	.1	....	.7	11.3	195
General average of fish, mollusks, crustaceans, etc	45.0	....	42.8	9.7	2.1	.2	.7	12.7	264
OTHER ANIMAL FOODS.									
Beef, side, medium fat	17.4	....	49.4	14.8	18.1	....	.7	33.6	998
Veal, side	22.6	....	55.2	15.6	6.3	....	.8	22.7	535
Mutton, side	19.3	....	43.3	13.0	24.0	....	.7	37.7	1,207
Average of beef, veal and mutton	19.4	....	49.3	14.5	16.1	....	.7	31.3	913
Pork, side	11.2	....	26.1	8.3	54.8	....	.4	63.5	2,363
Chicken	25.9	....	47.1	13.7	12.3	....	.7	26.7	744
Turkey	22.7	....	42.4	16.1	18.4	....	.8	35.3	1,034
Milk	....	....	87.0	3.3	4.0	5.0	.7	13.0	313
VEGETABLE FOODS.									
Wheat flour	....	....	12.0	11.4	1.0	75.1	.5	88.0	1,610
Corn meal	....	....	12.5	9.2	1.9	75.4	1.0	87.5	1,610
Wheat bread (from patent flour)	....	....	35.3	9.2	1.3	53.1	1.1	64.7	1,215
Beans, dried	....	....	12.6	22.5	1.8	59.6	3.5	87.4	1,560
Potato	20.0	....	62.6	1.8	.1	14.7	.8	17.4	303
Cabbage	15.0	....	77.7	1.4	.2	4.8	.9	7.3	122
Corn, canned	....	....	76.1	2.8	1.2	19.0	.9	23.9	445
Salad greens	....	....	86.7	4.2	.6	6.3	2.2	13.3	213
Apples	25.0	....	63.3	.3	.3	10.8	.3	11.7	213
Bananas	35.0	....	48.9	.8	.4	14.3	.6	16.1	290
Strawberries	5.0	....	85.9	.9	.6	7.0	.6	9.1	168
Sugar	....	....	....	....	....	100.0	....	100.0	1,860

The above list includes the more important food fishes, water invertebrates, etc. There are numbers of other fish which are eaten to a greater or less extent. In general it may be said their composition would be similar to that of the fishes included in the table.

In a number of cases cited in the table above more than one specimen was analyzed, although only the averages are given in the table. In such cases the samples showed more or less variation in total nutrients, but the variation was due more especially to the fats. Thus the fat in the flesh of seven specimens of shad ranged from 6.5 to 13.6 per cent.; in fresh mackerel from 2.2 to 16.3 per cent., and in fresh halibut from 2.2 to 10.6 per cent. The protein and ash or mineral matter remained practically the same in all the specimens where the wide fat variation was noticeable, an increase of fat being accompanied by a decrease of water.

An extended study of the chemical composition of fish was recently carried on at the zoological station at Naples by Lichtenfelt. It was found that the composition of the muscular tissue changes periodically with age, nutrition and reproduction. Under the influence of hunger the amount of water in the flesh is increased and the proportion of solids diminished. The richer the muscles in fat, the greater the loss as compared with lean fish. The amount of protein is also diminished not only in salmon, but in other sorts of fish. The amount of insoluble proteids is decreased while the proportion of soluble proteids may be either increased or lowered according to circumstances. Muscular activity in connection with hunger seems a condition especially suited to induce an increase of soluble proteids in fish flesh.

It will be seen from the table that fish is essentially a nitrogenous food. In this it resembles meat. Neither fish nor meat is a source of carbohydrates. Oysters and other shellfish contain some carbohydrates, but the foods which supply this group of nutrients most abundantly are sugar and the cereal grains. The place of fish in the diet, if judged by its composition, is, therefore, the same as that of meat—that is, it supplements cereals and other vegetables, the most of which, as wheat, rye, maize, rice, potatoes, etc., are deficient in protein, the chief nutrient in the flesh of fish. As regards the relative nutritive value of meat and fish, Atwater's conclusion, from a large number of investigations, was that the only considerable difference is in the proportion of water and fat present, the flesh of the fish having water where meat has fat.

From the standpoint of both nutritive value and palatability fish, according to a recent German investigator, is an important food product and, as shown by his experiments, equal to beef as a source of energy in the diet. It produces the same sensation of satiety and this persists for as long a time. It was found that fish caused the excretion of a smaller amount of uric acid than meat.

In general, it may be said that fish, meat, eggs, milk, etc., also cereals and vegetable foods, all supply fat, the amount varying in the different materials. Fish usually contains less fat than is found in meat. There is, however, much difference in the fat content of the various kinds of fish. They may, indeed, be roughly divided into three classes: The first class would include those containing over 5 per cent. fat; the second those containing between 2 and 5 per cent., and the third, those containing less than 2 per cent. The first group would include such fish as salmon, shad, herring, Spanish mackerel and butter-fish; the second, whitefish, mackerel, mullet, halibut and porgy; the third, smelt, black bass, bluefish, white perch, weakfish, brook trout, hake, flounder, yellow perch, pike, pickerel, sea bass, cod and haddock.

As regards nitrogenous constituents, fish flesh contains more gelatin-yielding material (collagen) and less extractive material (meat bases) than meat. As is well known, the characteristic red color of blood and muscular tissue is due to the presence of a substance called hemoglobin. The flesh and blood of fish contain less of this and allied coloring matters than meat, which accounts for the light color commanly observed in fish flesh. The flesh of some fishes, like salmon, has a decided color. It is not due, however, to hemoglobin, but to the presence of a special pigment.

The so-called nitrogenous extractives ("meat extract"), contained in small quantities in fish as in other foods, are doubtless useful in nutrition, although opinions have differed as to their real function. Recent investigations indicate very strongly that flesh extractives play an important part in stomach digestion, as they have been shown to induce an abundant flow of normal gastric juice. Many of the ordinary food materials possess this property also, but the flesh extractives seem to be especially suited to the purpose. They do not, it is true, furnish the body much food material, but they are nevertheless important if they normally help it to digest other foods.

With the exception of a few kinds which are preserved whole, preserved fish, as a rule, show a small percentage of refuse. The percentage of actual nutrients is much larger than in the corresponding fresh fish, owing to the removal of a large part of the refuse and more or less water. The gain in nutrients is mostly represented by protein, which is the most valuable nutrient.

Dried fish is richer in nutritive material, pound for pound, than fresh fish, since it has been concentrated by evaporation. It has been found that the average loss in weight in drying is about 30 per cent., or less than the average values for different kinds of meat. The loss in weight is chiefly due to the evaporation of water, though in some cases dried fish contains a little less ether extract than fresh fish.

When foods are cooked there is, generally speaking, a loss of weight owing to the evaporation of water, and in the ordinary methods of cooking fish and meat some nutritive material is lost also. In recent experiments it was found that the water in which fish was boiled contained 9 to 11 per cent. of the total fish protein.

Canned fish, which is in effect cooked fish, compares favorably as regards composition with the fresh material. Generally speaking, the amount of refuse is small, since the portions commonly rejected in preparation for the table have been removed before canning.

The various kinds of shellfish resemble meat and food fishes in general composition. They contain, however, an appreciable amount of carbohydrates. Oysters are the most important of the shellfish, judging by the relative amount consumed. Speaking roughly, a quart of oysters cantains on an average about the same quantity of actual nutritive substance as a quart of milk, or three-fourths of a pound of beef, or 2 pounds of fresh codfish, or a pound of bread; but, while the weight of actual nutriment in the different quantities of food materials named is very nearly the same, the kind is widely different. That of the lean meat or codfish consists of protein, the substance whose principal function is to make or repair blood, muscle, tendon, bone, brain, and other nitrogenous tissues. That of bread contains considerable protein, but a much larger proportion of starch, with a little fat and other compounds which supply the body with heat and muscular power. The nutritive substance of oysters contains considerable protein and energy-yielding ingredients. Oysters come nearer to milk than almost any other common food materials as regards both the amounts and the relative proportions of nutrients.

Apparently as the oyster grows older, at least up to a certain time, not only do the proportions of flesh and liquids increase more rapidly than the shells, but the proportion of nutrients in the edible portions increases also; that is to say, 100 pounds of young oysters in the shell appear to contain less of flesh and of liquids than 100 pounds of older ones, and when both have been shucked a pound of shell contents from the older oysters would contain more nutriment than a pound from the younger.

Considering the edible portion of the oyster, after it has been removed from the shell, the differences in different specimens are much greater than is commonly supposed. This is apparent when a comparison is made of either the flesh (meat) or liquids (liquor) of different specimens, or the whole edible portion, the meat (solids) and liquor together. The percentage of water in the edible portion of different specimens of oysters which were analyzed in experiments conducted for the U. S. Fish Commission varied from about 83.4 to 91.4 per cent., and averaged 87.3 per cent. This makes the amounts of "water-free substances," i. e., actually nutritive ingredients, vary from 16.6 to 8.6 and average 12.7 per cent. of the whole weight of the edible portion (shell contents) of the animals. In other words, the nutritive material in a quart (about 2 pounds) of shell contents (solids) varied from 2.75 to 5.33 ounces.

With oysters, long clams and round clams in the shell there is naturally a large percentage of waste, as the shell constitutes a large proportion of the total weight. The average of 34 specimens of oysters in the shell, for instance, shows only 2.3 per cent. of actual nutrients. Clams and mussels show a somewhat higher percentage.

Where these various shellfish are purchased as "solids"—that is, removed from the shell—a comparatively high price is usually paid. Where they are purchased in the shell, there is a very large percentage of waste. The conclusion is, therefore, warranted that, from a pecuniary standpoint, they are not the most economical of foods for the consumer. On the other hand, they have a useful place in the diet in helping to supply the variety which is apparently needed to insure the best

workings of the digestive system. Often flavor has a value which cannot be estimated in dollars and cents.

As already explained, it is a common practice of oyster dealers, instead of selling the oysters in the condition in which they are taken from the beds in salt water, to place them for a time—forty-eight hours, more or less—in fresh or brackish water, in order, as the oystermen say, to "fatten" them, the operation being also called "floating" or "laying out." By this process the oyster acquires plumpness and rotundity, and its bulk and weight are so increased as materially to increase its selling value. The belief is common among oystermen that this "fattening" is due to actual gain of flesh and fat, and that the nutritive value of the oyster is increased by the process. They find that the oysters "fatten" much more quickly in fresh than in brackish water. Warmth is so favorable to the process that it is said to be sometimes found profitable to warm artificially the water in which the oysters are floated. Although oysters are generally floated in the shell, the same effect may be obtained by adding fresh water to the oysters after they have been taken out of the shell. Oysters lose much of their salty flavor in "floating," and it is a common experience of oystermen that if the "fattened" oysters are left too long on the floats they become "lean" again.

It does not seem probable that the oysters would secure food enough to make appreciable gain in weight in the short time in which they remain in the fresh or brackish water.

It is known that when a solution of salts is separated by a suitable membrane from water containing a lesser quantity of salts in solution that the passage of salts immediately begins from the concentrated to the dilute solution. This is practically the condition which exists when the oyster is transferred from salt to fresh or brackish water. The fleshy portions of the body which are inclosed in a membrane contain salts in solution. As long as the oyster stays in salt water the solution of salts within its body would naturally be in equilibrium with the water outside. When the oyster is brought into fresh or brackish water, i. e., into a more dilute solution, it might be expected that the salts in the more concentrated solution within the body would pass out and a larger amount of fresh water enter and produce such a distention as actually takes place during floating. Careful experiments have shown that this supposition is entirely correct—that is, the oysters actually gain in weight. This is due largely to the fact that they lose mineral matter and gain a considerable amount of water. At the same time there is a slight loss of nutrients. When in their natural condition oysters contain from one-eighth to one-fifth more nutritive material than when fattened. In the opinion of very many consumers the improvement in appearance and flavor due to the removal of the salts more than compensates for the loss in nutritive value. It seems also to be a matter of common opinion that oysters keep better when part of the salts has been removed by "floating." However, the experiments of the New Jersey Experiment Stations have shown that freshened oysters will not remain alive as long as those taken directly from salt water. Freshening increases very rapidly the rate of weakening and decay (the life period being reduced one-half).

Frequently oysters become more or less green in color. There is a widespread opinion that "greening" is injurious. The color has been attributed to disease, to parasites, and to the presence of copper.

Experiments have shown that quite commonly the green color of American oysters at least is due to the fact that they have fed on green plants of very simple structure which are sometimes found to be abundant in salt or brackish waters. The green coloring matter of the plants is dissolved by the oyster juices and colors the tissues. The opinion of those who have investigated the matter carefully is that such green color is harmless. It may be removed, if desired, by placing the live oysters for a time in water where the green plants are not abundant. In Europe similar green oysters, called "groenbarden" or "Marennes," are especially prized, and to meet the demand oysters are greened by placing them as soon as captured in sea water, where they are kept for months and fed on a species of seaweed which imparts the coloring matter to the gills.

From carefully conducted investigations it appears that in some cases green oysters owe their color to the presence of copper. Such oysters are not generaly considered wholesome. Green oysters containing copper differ in appearance from those owing their green tint to vegetable coloring matter, being grass green and not dark green in color and having a verdigris-like slimy secretion on the folds of the mantle. It is said that after the addition of vinegar a steel fork stuck into such oysters becomes coated with copper, and that if ammonia is added the oysters become dark blue.

As will be seen by the figures in the table above, fresh and canned abalone correspond quite closely to oyster and clam products similarly prepared. As shown by some tests carried on by Jaffa and Mendel, abalone flesh is especially rich in glycogen. This fact is also emphasized by the figures in the table above, especially those for dried abalone, which are quoted from unpublished analyses made by Jaffa at the California Experiment Station. Generally speaking, compared with other sea products, the abalone is a nutritious food. Its flavor is said, by those who are familiar with it, to be excellent. Large quantities of abalone are canned, the flesh being cut into pieces of suitable size. Abalone is also dried extensively, the canned and the dried products finding a ready market among the Chinese.

Lobsters, crabs, shrimps and crawfish are shown by analysis to contain a fairly large percentage of nutrients, as is especially noticeable when the composition of the flesh alone is considered. They resemble the lean rather than the fat fish in composition. Lobsters and crabs are very much alike as regards the structure of the flesh, which in each case consists of coarse dense-walled fibers. Lobsters and similar foods are prized for their delicate flavor. Except in certain regions where they are very abundant and the cost correspondingly low, they must be regarded as delicacies rather than as staple articles of diet. This is, however, a condition entirely apart from their composition. Judged by this alone, they are valuable foods, and may profitably be employed to give variety to the diet.

Although the total amount of turtle and terrapin used in the United States is quite large, the quantity is small as compared with the consumption of such foods as fish proper and oysters. As shown by their composition, turtle and terrapin are nutritious foods, although under existing conditions, they are expensive delicacies rather than staple and economical articles of diet.

The total amount of frogs consumed per year for food is considerable. As shown by analysis, frogs' legs contain a fairly high percentage of protein. Only the hind legs are commonly eaten. The meat on other portions of the body is edible, although the amount is small, and is eaten in some localities. The prejudice which formerly existed against frogs' legs as a food was doubtless based on their appearance or some similar reason, as they are known to be wholesome.

COST OF PROTEIN AND ENERGY IN FISH AND OTHER FOOD MATERIALS.

As previously stated, the two functions of food are to furnish protein for building and repairing the body and to supply energy for heat and muscular work. Although fish and meats in general may be regarded as sources of protein, they nevertheless furnish considerable energy. Indeed, those containing an abundance of fat supply a large amount of energy—that is, have a high fuel value. If a food contains little protein or energy and is high in price, it is evident that it is really expensive. On the other hand, a food may be high in price but in reality be cheap, if it furnishes a large amount of protein or energy or both. Foods which supply an abundance of protein or energy or both at a reasonable price are evidently of the greatest importance from the standpoint of economy.

In the following table is shown how much a pound of protein, or 1,000 calories of energy, would cost when supplied by a number of kinds of fish and other foods at certain prices, and also the amount of total food, protein and energy which 10 cents' worth of the fish and other food materials would furnish.

COMPARATIVE COST OF PROTEIN AND ENERGY AS FURNISHED BY A NUMBER OF FOOD MATERIALS, AT CERTAIN PRICES.

Kind of food material.	Price per pound.	Cost of 1 pound protein.	Cost of 1,000 calories energy.	Amounts for 10 cts. Total wht. of food material.	Protein.	Energy.
	Cts.	Dllrs.	Cts.	Lbs.	Lbs.	C'l.rles
Codfish, whole, fresh........	10	0.90	48	1,000	0.111	209
Codfish, steaks	12	.71	36	.833	.142	274
Bluefish	12	1.20	58	.833	.083	172
Halibut	18	1.18	40	.556	.085	253
Codfish, salt	7	.44	23	1.429	.229	437
Mackerel, salt	10	.61	10	1.000	.163	998
Salmon, canned	12	.62	18	.833	.162	547
Oysters (solids, 30 cts. qt.).	15	2.50	68	.667	.040	147
Oysters (solids, 60 cts. qt.).	30	5.00	136	.333	.020	74
Lobster	18	3.05	129	.556	.033	77
Beef, sirloin steak...........	25	1.52	26	.400	.066	380
Beef, sirloin steak...........	20	1.21	21	.500	.083	475
Beef, round	14	.74	16	.714	.136	615
Beef, stew meat	5	.38	5	2.000	.266	1,862
Beef, dried, chipped	25	.95	33	.400	.106	303
Mutton chops, loin	20	1.48	14	.500	.068	694
Mutton, leg	22	1.46	25	.454	.069	394
Pork, roast, loin	12	.90	10	.833	.112	1,016
Pork, smoked ham	22	1.55	14	.454	.064	729
Milk (7 cents quart)........	3½	1.06	11	2 857	.094	891
Milk (6 cents quart)........	3	.91	10	3.333	.110	1,040
Wheat flour	3	.26	2	3.333	.380	5,363
Corn meal	2	.22	1	5.000	.460	8,055
Potatoes (90 cents bushel)..	1½	.83	5	6.667	.120	2,020
Potatoes (45 cents bushel)..	¾	.42	2	13.333	.240	4,040
Cabbage	2½	1.79	21	4.000	.056	484
Corn, canned	10	3 57	23	1.000	.028	444
Apples	1½	5.00	7	6.667	.020	1,420
Bananas	7	8.75	24	1.429	.011	414
Strawberries	7	7.78	42	1.429	.013	240

In the table the prices per pound have been selected from the best data available. It is, of course, impossible to set any one price which shall represent the cost of these materials per pound in all sections of the country and at all times of the year. It is probable that the prices given represent more nearly those found in the eastern part of the United States than in the southern, central and western sections, where some food materials are usually somewhat cheaper.

It is to be noted that the cost of 1 pound of protein and 1,000 calories of energy have no direct relation to each other. A pound of protein would be sufficient for a workingman about four days, while 1,000 calories of energy would be less than one-third the amount required per day. By dividing the cost of 1 pound of protein by 4 and multiplying the cost of 1,000 calories of energy 3.5 results are obtained which show approximately the relative cost of the protein and energy sufficient for one day as furnished by the different food materials. Thus it would take, in round numbers, 25 cents' worth of salt mackerel at 10 cents a pound to furnish one day's supply of protein, while the corresponding energy would require 38 cents' worth. Seven cents' worth of flour would furnish the protein and 5 cents' worth the energy required for one day. It is, course, understood that no one food material could furnish the nutrients in their proper proportions for adults under ordinary conditions of health and activity. The values expressed in the table simply show the relative value from a pecuniary standpoint of the different foods as a source of protein on the one hand and of energy on the other.

It will be seen from the above table that at 25 cents a pound it would take $1.52 worth of sirloin steak to furnish a pound of protein, while the same amount could be obtained in 74 cents' worth of beef round at 14 cents a pound, 71 cents' worth of cod steak at 12 cents a pound, 44 cents' worth of salt cod at 7 cents a pound, or 26 cents worth of wheat flour at 3 cents a pound. In like manner the cost of 1,000 calories of energy would vary in these same food materials from 36 cents, as furnished by the cod steaks, to 2 cents as furnished by the flour.

It is evident that at the prices given the fruits are the most expensive sources of protein, mollusks and crustaceans next, and the cheaper meats and fish, with the cereals, the least expensive. As regards energy, on the other hand, mollusks and crustaceans are by far the most expensive sources, followed by fish and many kinds of meat, while the cereals are the most economical.

DIGESTIBILITY OF FISH.

The term digestibility, as commonly employed, has several significations. To many persons it conveys the idea that a particular food agrees with the user. It is also very commonly understood to refer to ease or rapidity of digestion. One food is often said to be preferable to another because it is more digestible—i. e., is digested in less time in the stomach, or is apparently digested more readily. A third meaning, and one which is usually understood in scientific treatises on such subjects, refers to the completeness of digestion. For instance, two foods may have the same composition, but, owing to differences in mechanical condition or some other factor, one may be much more completely digestible than the other—that is, give up more material to the body in its passage through the intestinal tract.

The agreement or disagreement of a particulal food with any person in normal health is largely a matter of individual peculiarity. When foods habitually disagree with a person, and there is reason to believe that there is pronounced indigestion, the advice of a competent physician is needed, since the nourishment of an abnormal or diseased body is a matter properly included under the practice of medicine.

In so far as ease or rapidity of digestion implies a saving of energy to the body, it may be a matter of importance, especially if the energy expenditure would otherwise be above the normal. However, little is known concerning relative rapidity of digestion within the body. Most of the current statements which refer to this are apparently based on experiments carried on outside the body by methods of artificial digestion. Such experiments imitate as closely as possible the conditions in the body, but it is not at all certain that they are exactly the same. Some experiments with man, which were made a good many years ago, before experimental methods had become fixed, are also often quoted, but it is only fair to say that the popular inter-

pretation of the data recorded does not agree in many respects with that of trained investigators.

The numerous artificial digestion experiments which have been made with fish indicate that it is less quickly digested than beef, being about equal to lamb in this respect. However, as compared with other foods, the difference in the digestibility of fish and meat, as shown by these experiments, is not very great. In some carefully conducted experiments, which were reported only a few years ago by a German investigator, it was noted that oysters, whitefish and shellfish, taken in moderate amounts, left the stomach in two to three hours, in this respect resembling eggs, milk, white bread, and some other foods. Caviar left the stomach in three to four hours, as did also chicken, lean beef, boiled ham, beefsteak, coarse bread, etc. Salt herring left the stomach in four to five hours, other foods in the same class being smoked tongue, roast beef, roast goose, lentil porridge and peas porridge. So far as fish is concerned, the general deduction from these experiments was that it is more rapidly digested than meat. With respect to its rapidity of digestion in the stomach, another German investigator includes whitefish in the same class as the following animal foods: Roast chicken, pigeon, roast veal and cold underdone roast beef.

Before sweeping deductions are made the thoroughness with which fish is digested should also be taken into account. A number of experiments have been made with man to learn how thoroughly fish is digested and to compare it in this respect with other foods. In these experiments the food and feces were analyzed. Deducting the nutritive material excreted in the feces from the total amount consumed in the food showed how much was retained by the body. It was found that fish and lean beef were about equally digestible. In each case about 95 per cent. of the total dry matter, 97 per cent. of the protein, and over 90 per cent. of the fat were retained by the body. Other experiments of the same character indicate that salt fish is less thoroughly digested than fresh fish.

At the Connecticut (Storrs) Station Milner studied the digestibility of fresh (canned) salmon, a typical fat fish, and fresh cod, a typical lean fish, these materials each constituting a considerable part of a simple mixed diet. The calculated coefficients of digestibility of the salmon alone were protein 96.2 per cent. and fat 97 per cent., while 85.6 per cent. of the energy was available. In the case of the cod the values for protein and fat were 95.9 and 97.4 per cent., respectively, and for energy 80.3 per cent. It has been suggested that fat fish is less thoroughly digested than lean fish, but in these experiments the two sorts were digested on an average with practically the same thoroughness.

A number of similar experiments have been made on the digestibility of milk, eggs, bread, potatoes and other animal and vegetable foods. From a large amount of data of this sort some general deductions have been drawn. Thus, it has been calculated that 97 per cent. of the protein and 95 per cent. of the fat of meats, fish, eggs, dairy products and the animal food of a mixed diet are digested. Similar values are for the protein of cereals 85 per cent., for the fat 90 per cent., and for the carbohydrates 98 per cent.; for the protein, fat and carbohydrates of vegetables 83, 90 and 95 per cent., respectively, and for the protein, fat and carbohydrates of the total vegetable food of a mixed diet 84, 90 and 97 per cent. From the available experimental data it also seems probable that leaner meats are more easily digested than those containing more fat, and the leaner kinds of fish, such as cod, haddock, perch, pike, bluefish, etc., are more easily and readily digested than the fatter kinds, as salmon, shad and mackerel. Generally speaking, it has been found that the protein of vegetable foods as served on the table is less digestible than that of animal foods. For instance, one-fourth or more of the protein of potatoes and beans may escape digestion and thus be useless for nourishment. This is perhaps entirely due to the mechanical condition in which the protein occurs in vegetable foods; that is, it is often inclosed in cells which have hard walls and are not acted upon by the digestive juices. It is ordinarily assumed that the small amount of carbohydrates in meat and fish is entirely digested. Carbohydrates other than fiber, which make up the larger part of the vegetable foods, are very digestible. The fat in both animal and vegetable foods differs in digestibility under varying conditions. No marked difference in the digestibility of the fat in the two classes of food can be pointed out.

Persons differ in respect to the action of foods in the digestive apparatus; and fish, like other food materials, is subject to these influences of personal peculiarity.

The nutritive value of shellfish, as of other fish, depends to a considerable extent upon its digestibility, but information on this point is so limited that but little can be said with certainty here. Perhaps the most that can be said is that while there are people with whom such foods do not always agree, yet oysters belong to the more easily digestible class of foods. In a recently published study of the composition of the oyster and other problems connected with their food value, the statement is made that the nutrients occur largely in forms in which they are readily assimilated, as is shown by the fact that one-half of the crushed oyster and one-fourth of the whole oyster is soluble in water. So far as can be learned no experiments have been made which show how thoroughly clams, crabs and other crustacea, turtle and terrapin, and frogs' legs are digested.

PLACE OF FISH IN THE DIET.

The chief uses of fish as food are to furnish an economical source of nitrogenous nutrients and to supply the demand for variety in the diet, which increases with the advance of civilization.

Inspection of a considerable number of dietary studies of families of farmers, mechanics, professional men and others, carried on in different regions of the United States, shows that about 20 per cent. of the total food, 43 per cent. of the total protein and 55 per cent. of the total fat of the diet of the average family is obtained from meats, poultry, fish, shellfish, etc., together. Fish, shellfish, etc., alone furnish less than 3 per cent. of the total food, less than 4 per cent. of the total protein, and less than 1 per cent. of the total fat, showing to what a limited extent such food is used in the average household. It is not improbable that in communities where fisheries constitute the principal industry much larger quantities are consumed. It has been found that the laborers employed in the fisheries in Russia consume from 26 to 62 ounces of fish daily. This, with some bread, millet meal and tea constitutes the diet throughout the fishing season. These quantities are unusually large, but no bad effects are mentioned as following the diet.

There is a widespread notion that fish contains large proportion of phosphorus, and on that account is particularly valuable as brain food. The percentages of phosphorus in specimens thus far analyzed are not larger than are found in the flesh of other animals used for food. But, even if the flesh be richer in phosphorus, there is no experimental evidence to warrant the as-

sumption that fish is more valuable than meats or other food material for the nourishment of the brain.

The opinion of eminent physiologists is that phosphorus is no more essential to the brain than nitrogen, potassium, or any other element which occurs in its tissues. The value commonly attributed to the phosphorus is based on a popular misconception of statements by one of the early writers on such topics. In discussing the belief that "fish contains certain elements which are adapted in a special manner to renovate the brain and so to support mental labor" a prominent physiologist says: "There is no foundation whatever for this view."

It is well understood that persons in varying conditions of life and occupation require different kinds and quantities of food. For the laboring man doing heavy work the diet must contain a comparatively large amount of the fuel ingredients and enough of the flesh-forming substances to make good the wear and tear of the body. These materials are all present in the flesh of animals, but not in the requisite proportions. Fish and the leaner kinds of meat are deficient in materials which yield heat and muscular power. When, however, fish and meat are supplemented by bread, potatoes, etc., a diet is provided which will supply all the demands of the body. Where fish can be obtained at low cost it may advantageously furnish a considerable portion of the protein required, and under most conditions its use may be profitably extended solely on the plea of variety.

It should be stated that most physiologists regard fish as a particularly desirable food for persons of sedentary habits, because it seems to be less "hearty." While, so far as can be learned, such statements do not depend upon experimental evidence, they are thought to embody the result of experience.

PREPARING FISH FOR THE TABLE.

Fish is prepared for the table in a variety of ways, which are described in detail in books devoted to cookery. A few words, however, may not be inappropriate on the general methods of cooking and possible loss of nutrients involved.

Fish is commonly boiled, steamed, broiled, fried or baked, or may be combined with other materials in some made dish. When boiled, it is stated that the loss in weight ranges from 5 to 30 per cent. One experimenter gives 26 per cent. as the average. This loss is largely made up of water—that is, the cooked fish is much less moist than the raw. Little fat or protein is lost. So far as known, experiments have not been made which show the losses by other methods of cooking. It is, however, probable that there would be usually a very considerable loss of water.

In most cases fat or carbohydrates in the form of butter, flour or other material are added to fish when cooked, and thus the deficiency in fuel ingredients is made good. Boiled or steamed fish is often accompanied by a rich sauce, made from butter, eggs, etc. Fried fish is cooked in fat, and baked fish is often filled with forcemeat, and may also be accompanied by a sauce; the forcemeat being made of bread, butter, etc., contains fat and carbohydrates. In made dishes—chowders, fish pies, salads, etc.—fat and carbohydrates (butter, flour, vegetables, etc.) are combined with fish, the kind and amount varying in the individual cases. Furthermore, in the ordinary household, fish or meat is supplemented by such foods as bread, butter, potatoes, green vegetables, and fruit. That is, by adding materials in cooking and by serving other dishes with the cooked product the protein of the fish is supplemented by the necessary fat and carbohydrates.

DAILY MENUS CONTAINING FISH.

By taking into account the chemical composition of a mixed diet and comparing it with accepted dietary standards it may be seen whether the diet is actually suited to the requirements of the body; that is, whether it supplies sufficient protein and energy and whether it supplies them in the right proportions.

A number of sample menus show that the desired amounts of protein and energy may be readily supplied by a diet containing a considerable amount of fish. These menus (which are based in part on dietary studies and other food investigations of this Department covering a wide range and extending over several years) are not intended as formulas for any family to follow, but simply as illustrations of the way in which menus containing the proper proportions of nutrients may be made up. The ingenuity of the housewife and her knowledge of the tastes of the family will suggest the special dishes and combinations suited to her needs. It is not assumed that any such housewife will find it convenient to follow exactly the proportions suggested in the menus. The purpose is to show her about what amounts and proportions of food materials would give the required nutrients.

In selecting these menus it has been the object to include such amounts of fish as might be commonly served in an ordinary household and not to provide meals with the largest possible quantity of fish. That the amount which it is possible to introduce in a single meal may be large is shown by the "shore dinners" so common at some regions of New England, or by the famous dinners served at Greenwich on the Thames, with six courses and fish in every course.

With reference to the following menus several points should be borne in mind. The amounts given represent about what would be called for in a family whose demand for food would be equivalent to four full-grown men at light to moderate manual labor, such as machinists, carpenters, mill workers, farmers, truckmen, etc., according to the usually accepted dietary standards. It is ordinarily assumed that an average man in health performing light to moderate muscular work requires per day about 0.25 pound protein and 3,050 calories of energy, the latter being supplied in small part by protein, but mostly by fat and carbohydrates. Men in professional life, performing less muscular work, require smaller amounts. The commonly accepted American dietary standard for such men calls for 0.22 pound protein and 2,700 calories of energy in the daily food. The amount of mineral matter required is not stated, since there is little accurate information available on this point. A diet made up of ordinary foods and supplying the necessary amounts of protein and energy would undoubtedly supply an abundance of mineral matter.

It has been found that women and children consume somewhat less food than men. The assumption is usually made that, provided a woman is engaged in some moderately active occupation, she requires about eight-tenths as much food as a man with a similar amount of work.

In calculating the results of dietary studies (which may be most conveniently expressed in amounts for one man for one day), it is further assumed that a boy 13 to 14 years old and a girl 15 to 16 years old also require about eight-tenths as much food as a man at moderately active muscular labor; a boy of 12 and a girl 13 to 14 years old, about seven-tenths; a boy 10 to 11 and a girl 10 to 12 years old, about six-tenths; a child 6 to 9 years old, about five-tenths; one 2 to 5, about four-tenths, and an infant under 2 years, about three-tenths.

As previously stated, the quantities in the sample

menus are for four men at moderately active muscular work or an equivalent number of men, women and children. A family might, for example, consist of a mechanic and wife, with four children, two girls of 12 and 6 and two boys of 10 and 8 years, respectively. Here it would be assumed that the man would be engaged at moderately hard manual work. According to the above factors, this family would be equal in food consumption to 4 men at moderate muscular exercise. In the same way a day laborer's family, consisting of a father and mother with three children under 7 years of age, would be equivalent to three men with moderate muscular exercise, and would require three-fourths the quantities indicated in the following menus:

MENU I—FOR FAMILY EQUIVALENT TO FOUR MEN AT LIGHT TO MODERATE MUSCULAR WORK.

Food Material.	Am'nt used.		Protein.	Fuel value.
BREAKFAST.	Lbs.	oz.	Pound	Cal'ri's
Oranges	2	0	0.012	338
Omelet (8 eggs)	1	0	.131	613
Butter for frying	0	1	.001	216
Johnnycake	1	4	.099	1,466
Butter	0	3	.002	647
Coffee	......		.008	248
Total	......		.253	3,528
DINNER.				
Boiled cod, fresh	2	0	.340	658
Hollandaise sauce:				
Butter	0	4	.002	863
Yolks of 2 eggs	0	1⅓	.013	135
Lemon juice, etc.	......		......	......
Potatoes	2	0	.036	606
Boiled rice	1	8	.018	362
Milk	0	6	.012	117
Sugar	0	3	.....	340
Bread	0	12	.069	887
Butter	0	3	.002	647
Total	......		.492	4,615
SUPPER.				
Scalloped oysters:				
Oysters	2	0	.120	442
Crackers	0	4	.027	464
Butter	0	2	.001	431
Milk	0	4	.008	78
French fried potatoes	1	0	.018	303
Lard	0	2	.....	505
Bread	0	8	.046	592
Butter	0	2	.....	431
Sliced bananas	1	0	.008	290
Sugar	0	3	.....	340
Tea	......		.008	248
Total	......		.237	4,124
Total per day	......		.982	12,267
Total for one man	......		.246	3,067

MENU II—FOR FAMILY EQUIVALENT TO FOUR MEN AT LIGHT TO MODERATE MUSCULAR WORK.

Food Material.	Am'nt used.		Protein.	Fuel value.
BREAKFAST.	Lbs.	oz.	Pound	Cal'ri's
Codfish creamed:				
Salt cod	0	8	0.080	153
Milk	1	0	.033	312
Butter	0	1	.001	216
Flour	0	1	.007	101
Baked potatoes	1	12	.044	721
Bread	0	12	.069	887
Butter	0	4	.002	863
Coffee	......		.008	248
Total	......		.244	3,501
DINNER.				
Clam soup:				
Clams, round	0	12	.049	158
Milk	1	12	.057	545
Butter	0	1½	.001	324
Flour	0	1	.007	101
Onion, salt, pepper, etc.	......		.....	.....
Roast lamb, leg	1	8	.238	1,256
Green peas	1	8	.054	377
Butter	0	2	.001	431
Mashed potatoes	1	8	.039	737
Bread	0	6	.034	444
Butter	0	1	.001	216
Apple tapioca pudding	1	0	.003	541
Total	......		.484	5,130
SUPPER.				
Lobster salad:				
Lobster meat	1	0	.164	377
Yolks of 3 eggs	0	2	.020	202
Butter or oil	0	3	.002	647
Milk	0	7	.014	137
Sugar	0	1	.....	113
Vinegar, salt, pepper, mustard	......		.....	.....
Biscuit	0	12	.065	950
Butter	0	4	.003	863
Tea	......		.008	248
Total	......		.276	3,537
Total per day	......		1.004	12,168
Total for one man	......		.251	3,042

MENU III—FOR FAMILY EQUIVALENT TO FOUR MEN AT LIGHT TO MODERATE MUSCULAR WORK.

Food Material.	Am'nt used.		Protein.	Fuel value.
BREAKFAST.	Lbs.	oz.	Pound	Cal'ri's
Breakfast cereal:				
Cracked crushed wheat	0	4	0.028	410
Milk	0	6	.012	117
Sugar	0	2	.....	227
Creamed dried beef:				
Dried beef	0	12	.198	568
Milk	0	8	.017	156
Butter	0	1	.001	216
French fried potatoes	1	0	.018	303
Butter (taken up in frying)	0	2	.001	431
Bread	0	12	.069	887
Butter	0	3	.002	647
Coffee	......		.008	248
Total	......		.354	4,210
DINNER.				
Halibut steak	1	12	0.268	796
Mashed potatoes	2	0	.052	982
Tomatoes (or half am't of parsnips)	2	0	.018	206
Bread	0	12	.069	887
Butter	0	3	.003	647
Apple pie	1	0	.031	1,228
Total	......		.441	4,746
SUPPER.				
Salmon croquettes:				
Canned salmon	0	8	.098	328
Mashed potatoes	1	0	.026	491
Butter	0	1	.001	216
1 egg	0	2	.016	77
Prune sauce	1	0	.005	418
Muffins	0	12	.065	950
Butter	0	3	.002	647
Tea	......		.008	248
Total	......		.221	3,375
Total per day	......		1.016	12,331
Total for one man	......		.254	3,083

MENU IV—FOR FAMILY EQUIVALENT TO FOUR MEN AT LIGHT TO MODERATE MUSCULAR WORK.

Food Material.	Am'nt used.		Protein.	Fuel value.
BREAKFAST.	Lbs.	oz.	Pound	Cal'ri's
Breakfast cereal:				
Cracked crushed wheat	0	4	0.028	410
Milk	0	6	.012	117
Sugar	0	2	......	227
Broiled salt mack'l	1	6	.191	1,524
Boiled potatoes	1	0	.018	303
Hot rolls	0	12	.067	1,017
Butter	0	3	.002	647
Coffee	......		.008	248
Total	......		.326	4,493

Food Material.	Am'nt used.		Protein.	Fuel value.
DINNER.	Lbs.	oz.	Pound	Cal'ri's
Broiled beefsteak	1	8	.248	1,424
Baked potatoes	1	8	.038	618
Onions	2	0	.028	398
Celery	1	0	.009	68
Bread	0	12	.069	887
Butter	0	3	.002	647
Baked apples:				
Apples	1	0	.003	213
Sugar	0	2	......	227
Milk	0	4	.008	78
Total	......		.405	4,560

Food Material.	Am'nt used.		Protein.	Fuel. value.
SUPPER.	Lbs.	oz.	Pound	Cal'ri's
Oyster stew:				
1¼ pints oysters	1	4	.075	276
1 pint milk	1	0	.033	312
Butter	0	1	.001	215
Crackers	0	6	.042	716
Bread	0	8	.046	592
Butter	0	2	.001	431
Choc'late layer cake	0	8	.031	801
Tea	......		.008	248
Total	......		.237	3,591
Total per day	......		.968	12,644
Total for one man	......		.242	3,161

The weights of fish, meats and vegetables given in the menus are for these articles as found in the market. The fish and meats will include, as a rule, more or less bone, and the vegetables considerable skin and other parts, which are inedible and are rejected. In estimating the nutrients allowance is made for what has been found to be the average proportion of bone in different cuts of meats. In vegetables it is assumed that from one-sixth to one-fifth will be rejected in preparing them for the table. The weights of the breakfast cereals are for these in the dry condition before cooking.

The values given for tea or coffee are obtained by taking account of the sugar and milk or cream consumed with them. The infusion of tea or coffee contains little, if any, nutritive material. The value of tea and coffee in the diet depends upon their agreeable flavor and mild stimulating properties.

The calculations of the quantities of nutrients contained in the different foods are based upon the average percentage composition of these materials, some of the data being included in the table of composition on page 40 and the remainder in a previous publication of the United States Department of Agriculture.

The fats and carbohydrates in the different food materials are not shown in the menus, since the quantity of protein and the fuel value of the food are the values which are of special interest. The fuel value of the fats and carbohydrates is, of course, included in the figures for fuel value given.

In the menus only such an amount of each food is indicated as might be completely consumed at each meal. Of course, in the ordinary household usually a rather larger quantity of the different dishes will be prepared than will be consumed at one meal, but the thrifty housekeeper will see to it that what is not used at one meal will be utilized for another.

It is not expected that each meal or the total food of each individual day will have just the amounts of protein and fuel ingredients that make a well-balanced diet. The body is continually storing nutritive materials and using them. It is a repository of nutriment which is being constantly drawn upon and as constantly resupplied. It is not dependent any day upon the food eaten that particular day. Hence an excess one day may be made up by a deficiency the next or vice versa. Healthful nourishment requires simply that the nutrients as a whole during longer or shorter periods should be fitted to the actual needs of the body.

It will be seen that in each of the menus suggested fish occurs in at least two meals. However, in no case is the amount greater than experience has shown may commonly occur in actual dietaries. It is not the intention to suggest that a diet containing such quantities of fish be followed every day, but rather to show that fish may be readily combined with other food materials to supply the protein and energy required. While it may profitably be used more frequently in many families than is at present the case, the quantity used is a matter to be settled by the demands of individual taste.

The menus attempt to cover, as regards fish and other materials, a range in variety and combination such as might be found in an average well-to-do household. Other dishes, such as fish soups, chowders, fish salads, etc., might have been included also, and would naturally find a place on the table of a family fond of fish and fish products. Individual preferences vary so much that no combination which could be selected would meet them all.

Nothing has been said of the cost of the food used in the menus. All foods vary in price in different localities, and this is especially the case with fish. In general it may be said that a large variety of fruits, green vegetables, etc., if it is necessary to purchase them, increases the cost of a diet out of proportion to the nutritive material furnished. Such foods, however, are valuable, since they possess agreeable flavor and so render the diet appetizing. It is also generally believed that the acids, salts and similar materials in fruits and vegetables are of value in maintaining the body in health. The income of the purchaser should determine how varied the diet may be.

POSSIBLE DANGERS FROM EATING FISH.

In view of the statements of a popular nature which have been made on the dangers from eating poisonous fish or from ptomaines contained in fish, a few words summarizing the actual knowledge on these topics seem desirable.

There are several species of fish which are actually poisonous. Few of them, however, are found in the United States, and the chances of their being offered for sale are very small. Such fish are mostly confined to tropical waters.

Fish may contain parasites, some of which are injurious to man. These are, however, destroyed by the thorough cooking to which fish is usually subjected.

Ptomaines are poisonous bodies due to the action of micro-organisms. They are chemical compounds of definite composition and are elaborated by micro-organisms breaking down the complex ingredients of animal tissues, just as alcohol is due to the action of yeasts breaking down sugar, or as acetic acid is formed from the alcohol of cider or wine by the yeast-like plant which produces vinegar, and which we call mother when we find it collected in masses. The formation of ptomaines quite generally, although not always, accompanies putrefaction (being greatest, it is said, in its early stages), and therefore great care should be taken to eat fish only when it is in perfectly good condition. Fish which has been frozen and, after thawing, kept for a time before it is cooked, is especially likely to contain injurious ptomaines.

Decomposition can often be recognized by the odor of the fish, especially when it has progressed to any considerable extent. There are laboratory tests for showing decomposition at various stages and for indicating the presence of ptomaines.

In general it may be said that fish should be considered unfit for food when the eyes have lost their sheen, the cornea is somewhat cloudy, the gills pale red, when blubber shows at the gills, when the scales are dry or easily loosened, or when the meat is so soft that if pressed with the finger the indentation remains. Laying fish in water has been recommended as a means of judging of their condition. Those which sink may be considered undecomposed and wholesome, while those which are decomposing will float.

Canned fish should never be allowed to remain long in the can after opening, but should be used at once. There is some possibility of danger from the combined action of the can contents and oxygen of the air upon the lead of the solder or the can itself. Furthermore, canned fish seems peculiarly suited to the growth of micro-organisms when exposed to the air.

Finally, fish offered for sale should be handled in a cleanly manner, and stored and exposed for sale under hygienic conditions.

A kind of poisoning called mytilism, usually very fatal in its results, has been sometimes observed to follow the eating of clams. The reason for this illness is not definitely known, though it is attributed to a poisonous body sometimes found in clams, especially in the liver. Just why this poisonous body occurs is not known, but it is probably due to a disease or some abnormal condition; furthermore, it has been noted that clams from some regions are quite uniformly poisonous. It is said that poisonous clams are less pigmented (lighter with radiate streaks) than wholesome clams, which are uniformly darkly pigmented, and that the shells of the unwholesome clams are more friable and broader, and that the liver is larger, softer and richer in pigment and fat. A well-known writer on the subject recommends that the public should be warned against buying dead clams—that is, those which do not close the shell when taken out of the water—and that as a further precaution the liver and the broth should not be eaten, if cases of mytilism have recently occurred locally or there is any other reason to suspect the clam supply.

Slight or serious poisoning has also been known to follow the eating of oysters, though fortunately American oysters have been seldom found to be a cause of such illness. As in the case of clams, the reason for such illness is not definitely known, but it is probably due to the occasional presence in oysters of some poisonous body due to disease or a similar cause. An European investigator reached the conclusion that the oysters are generally diseased in the summer months, though the nature of the disease was not learned. He found that the diseased oysters possessed a characteristic milky appearance and that the liver was much enlarged, gray and soft. It does not seem probable that American oysters are generally diseased during the summer months, as many who live in the oyster-producing regions eat them throughout the year, yet in view of the fact that bad results from eating shellfish are more frequently noticed in the summer than in the cooler months, possibly because they spoil more readily, omitting them from the bill of fare during the summer

seems a wise precaution. Oysters dead in the shell or those which are decomposed should under no circumstances be eaten. When removed from the water good oysters close the shell, move when touched, are of normal size and color, and have a clear fluid inside the shell. In the case of oysters dead when taken from the water, the shells remain open, while those which are decomposed are discolored and very soft, have a stale odor and show a blackish ring on the inside of the shell.

Oyster beds should be free from sewage, pollution, and oysters when "floated" or "fattened" should never be placed in water contaminated by sewage. Severe illness and death have resulted in many cases from eating raw oysters contaminated with sewage containing typhoid fever germs.

It is only just to say that the dangers from parasites, micro-organisms, ptomaines and uncleanly surroundings are not limited to fish. Under conditions which favor the growth of the micro-organisms, meat and other highly nitrogenous animal foods undergo decomposition resulting in the formation of ptomaines. Animal parasites may be acquired from flesh of various kinds if not throughly cooked, provided, of course, the flesh is infested. This danger is reduced by proper inspection. Vegetable foods also may become contaminated in various ways. The importance of measures to secure pure and wholesome food can hardly be overstated. The best interests of the people undoubtedly demand a strict and impartial supervision by public officers of the sale of food products.

EGGS AND THEIR USES AS FOOD

Perhaps no article of diet of animal origin is more commonly eaten in all countries or served in a greater variety of ways than eggs. Hens' eggs are most common, although the eggs of ducks, geese and guinea fowls are used to a greater or less extent, guinea eggs being prized for their delicate flavor. More rarely turkeys' eggs are eaten, but they are generally of greater value for hatching. In South Africa, where ostrich raising is an important industry, the eggs are used as food to some extent and are said to be of excellent quality for cookery. Their food value is also recognized in those regions in the United States where ostriches are raised.

The eggs of some wild birds are esteemed a delicacy. Plover eggs are prized in England and Germany, while in this country the eggs of sea birds have long been gathered for food. On the eastern shore of Virginia eggs of the laughing gull are frequently eaten, and the eggs of gulls, terns and herons were a few years ago gathered in great quantities along the coast of Texas. Thousands of eggs of gulls and murres have been gathered annually on the Farallone Islands, off the coast of California.

Other eggs besides those of birds are sometimes eaten. Turtle eggs are highly prized in most countries where they are abundant. They were once more commonly eaten in America than now, possibly owing to the more abundant supply in former times. The eggs of the terrapin are usually served with the flesh in some of the ways of preparing it for the table. Fish eggs, especially those of the sturgeon, are eaten in large quantities, preserved with salt, under the name of caviar. Shad roe is also a familiar example of the use of fish eggs as food. Mention may also be made of the use of the eggs of alligators, lizards, serpents, and some insects by races who lack the prejudices of Western nations. However, in general, the term eggs, when used in connection with food topics, refers to the eggs of birds, usually domestic poultry, and is so used in this bulletin.

The appearance of an egg—the shell with its lining of membrane, inclosing the white and yolk—is too familiar to need any discussion. The physiological structure of the egg is perhaps less familiar. A fertile egg contains an embryo and is at the same time a storehouse of material for the development and growth of the young individual from the embryo, until it has reached such a stage that life is possible outside the narrow limits of the shell. The embryo is situated quite close to the yolk, which furnishes the nutritive material for its early development, the white being used later.

For convenience, birds may be divided into two groups: (1) Those in which the young are hatched full-fledged and ready in a great measure to care for themselves, and (2) those in which the young are hatched unfledged and entirely dependent upon the parents for some time. Domestic poultry are familiar examples of the first group; robins and sparrows of the second. The eggs of the two classes differ materially in composition. It seems evident that more nutritive material is needed proportionally in the first case than in the second, since the growth is continued in the egg until the bird reaches a more advanced stage of development. The quite marked differences in composition of the two sorts of eggs have been shown by chemical studies, but need not be referred to further in the present discussion.

Since in all cases the egg is designed to furnish the sole source of material for growth and development of the young individual for a considerable time, it is evident that it must contain all the elements required; that is, that it must be a perfect food for the purpose intended. Milk is another familiar example of animal food containing all the elements of a complete food for the young and growing individual. Milk and eggs are frequently spoken of as perfect foods on this account. The designation is, however, misleading, for, although it is true that they contain all the required elements for the growth and maintenance of the young bird or the young mammal, as the case may be, the elements are not in the right proportion for the sole nourishment of an adult individual. The food value of eggs is discussed in greater detail beyond.

COOKING AND SERVING EGGS.

The methods of serving eggs alone or in combination with other food materials are very numerous. Cooked in various ways they are a favorite animal food, taking the place of meat to a certain extent, while raw eggs, usually seasoned in some way, are by no means infrequently eaten. Boiled eggs are often used for garnishing or ornamenting different foods. Eggs are combined with other materials in various ways in many made dishes. They are used in making cakes and such foods to improve their flavor, color and texture, while in custards, creams, etc., they thicken the material and give it the desired consistency. The white of the egg is also employed in making icings and confectionery. Well-

beaten or whipped egg white is used to leaven many forms of cakes and similar foods, as well as to improve the flavor. The beaten white incloses air in small bubbles, which become distributed throughout the mass of dough in mixing. The heat of cooking expands the air and makes the walls of the air bubbles firm, so that the porous structure is retained. The power to inclose and retain air when beaten varies, being greatest in the fresh egg and much lessened in packed or old eggs. Convenient leavening powders have lessened the number of eggs used for this purpose. Sponge cake, however, is a familiar example of food so leavened. This use of eggs explains some of the recipes in old cookery books which call for such large numbers of eggs. These uses are all familiar; the reasons for them are doubtless seldom thought of.

There are several simple ways of cooking eggs which are very commonly followed. Thus, the egg in the shell is cooked by immersion in hot or boiling water or is less commonly roasted. After removal from the shell the egg is cooked in hot water or in hot fat. In the latter case it may or may not be beaten or stirred. Combined with other materials to form various made dishes, eggs are boiled, baked, steamed or fried, as the case may be. The total number of methods of serving and preparing eggs is very large, but in nearly every case it will be found that the method of preparation is only a more or less elaborate modification of one of the simple methods of cooking.

Changes in weight, which are dependent on the methods of cooking, are commonly noted when foods are prepared for the table, losses in weight being due in general to the volatilization and gains to the absorption of water. Carpiaux found that when eggs were cooked for an hour in a steam bath the loss in weight was insignificant, ranging from 0.03 to 0.1 gram per egg. Camus found that with boiled eggs there was more or less loss, owing to evaporation of a little water through the porous shell. If the egg cooled in the water, it absorbed a little of it and gained in weight. The method of manipulation must have some effect on the changes in weight, for Lebbin reports that boiled eggs gained on an average about 0.5 gram, probably because a little water passed through the shell. From the tests as a whole it is evident that the changes in weight in all cases are small and not sufficient to modify the food value to any appreciable extent.

When cooked in different ways there are marked changes in the appearance and structure of eggs. As ordinarily applied, the term "boiled eggs" refers to eggs cooked in the shell in hot, though not necessarily boiling, water. The resulting product varies greatly, according to the length of time the cooking is continued, the method of procedure, etc. Perhaps the most usual household method of "boiling eggs" is to immerse them for a longer or shorter time in boiling water. An egg placed in boiling water not over 2 minutes will have a thin coating of coagulated white next the skin, the remainder will be milky, but not solid, while the yolk, though warm, will be entirely fluid. This stage may be called "very soft boiled." If the egg is kept in boiling water 2 minutes, or a little over, the white becomes entirely coagulated. The egg thus cooked may be termed "waxy." If the boiling is extended to 3 minutes or so, the egg shows a tendency to rise in the water and will be solid throughout, i. e., "solid boiled." If the boiling in continued up to 10 minutes or longer, the "hard-boiled" egg results. The white of such an egg is hard and elastic and the yolk crumbles readily. All these changes are due principally to the more or less complete coagulation and hardening of the albumen of the egg by heat.

Numerous experiments have been made to show the changes which actually take place when egg albumen is heated. If the egg white is gently warmed, no change is noted until the temperature reaches 134° F., when coagulation begins. White fibers appear, which become more numerous, until at about 160° F. the whole mass is coagulated, the white almost opaque, yet it is tender and jelly-like. If the temperature is raised to 212° F. (the temperature of boiling water) and continued, the coagulated albumen becomes much harder and eventually more or less tough and horn-like; it also undergoes shrinkage. When the whole egg is cooked in boiling water, the temperature of the interior does not immediately reach 212° F., several minutes being probably required. It has been found by experiment that the yolk of egg coagulates firmly at a lower temperature than the white.

The changes in the albumen noted above suggest the idea that it is not desirable to cook eggs in boiling water in order to secure the most satisfactory product. Those who have given attention to the science as well as the practice of cookery recommend "soft-cooked," "medium-cooked" and "hard-cooked" eggs, all of which are cooked at a temperature lower than 212° F. In soft-cooked eggs, properly prepared, the white resembles a soft, thick curd, while the yolk is fluid. Except for a suggestion of rawness, there will be little flavor, provided fresh eggs are used. Medium-cooked eggs are more thoroughly cooked than those just mentioned, the results being secured by long cooking or by a somewhat higher temperature. The white is soft and tender and the yolk slightly thickened. The favor (which is developed by cooking) is more pronounced than that of a soft-cooked egg and is generally considered more agreeable.

When an egg is covered with boiling water in a bain-marie or double boiler, and the temperature of the water in the outer vessel maintained at 180-190° F. for 30 to 45 minutes, the hard-cooked egg results, with the yolk dry and mealy and the white solid, yet tender.

The directions given for preparing soft-cooked, medium-cooked and hard-cooked eggs vary. The methods described in standard cookery books without doubt give the desired results if sufficient care is exercised. The chief difficulty encountered by most cooks is to secure uniform results, especially with soft-cooked and medium-cooked eggs. It must be remembered that such results cannot be expected when conditions vary. The time of cooking, the amount of water used, the number, size and freshness of the eggs, and the kinds of vessels used are important factors. Thus, eggs which have been kept in an ice chest require more heat to warm them before cooking begins than do those which have been kept at room temperature. Again, so apparently trivial a detail as the sort of vessel used (whether earthen or metal) or the place where the vessel stands during cooking may produce very different results. Many persons prefer to have eggs cooked at table in a chafing dish or other suitable vessel. In such cases the conditions may be controlled with comparative ease and uniform results obtained with a little practice if care is observed.

The following methods of preparing soft-cooked and medium-cooked eggs have been found to give uniform results in laboratory tests at the University of Illinois: Using a granite-ware stewpan of 1 quart capacity, 1 pint of water was heated over a gas flame; when the water boiled the gas was turned off and an egg which had been kept in a refrigerator was dropped into the

water. Without disturbing the vessel it was covered closely and the egg allowed to remain in the water 6 minutes. It was then soft cooked. As shown by tests, when the egg was dropped into the water the temperature fell almost at once to 185° F. and then slowly to 170-171° F. If the egg remained in the water 8 minutes it was medium cooked, the temperature of the water at the end of the period having fallen to 162-164° F.

Uniform results can be obtained in the kitchen as well as in the laboratory if sufficient attention is given to details. Bearing clearly in mind the end desired, each cook must experiment for herself, as it is impossible to give directions which will apply to all cases.

The same changes which have been noted above as taking place in egg yolk and white when heat is applied in preparing boiled eggs take place when other methods of cooking are followed, though they are not always apparent.

Poached or dropped eggs are removed from the shell and then cooked in water. Thudichum recommends the use of salted water to which a very little vinegar has been added. The reason for this is perhaps that acetic acid (vinegar) tends to precipitate albumen—that is, to prevent a loss due to some of the egg being dissolved in the water. Flavor may also be one of the objects sought.

Fried eggs are generally cooked in a flat pan, in a little hot fat, oil or butter, and may be either soft or hard, according to the length of time employed in the process. Eggs are also occasionally baked in much the same manner that they are fried.

The omelet is generally regarded as one of the most appetizing forms in which eggs can be served. It consists of the beaten egg with a little milk, water, and cream or melted butter added, quickly cooked in a little fat or butter in a suitable pan, and folded over so that it may be turned out of the pan in a half-round form. Some cooks insist that the best omelets are made by using hot water instead of milk or cream. The hot water is stirred into the egg yolk in the proportion of 1 tablespoonful to an egg. Scrambled eggs resemble an omelet in method of preparation, but no effort is made to preserve the characteristic form and appearance of the omelet. Generally speaking, lightness is desired in an omelet and thorough mixing in scrambled eggs. The former is secured by beating; the latter by stirring. Omelets are sometimes made with the addition of various materials, such as parsley, jams, etc. Many so-called omelets are made in which flour is used. These are more properly pancakes, and vary very greatly according to the ingredients used. Such dishes, as well as sweet omelets, etc., are treated of in cookery books, as are also many other ways of serving eggs, which are in principle the same as those already noted, but in which the final appearance is more or less modified.

The foods in which eggs are combined with other materials range from a simple custard or cake to the most elaborate of the confectioner's products. In all such dishes, as previously noted, eggs are used to give consistency, color, flávor or lightness.

Eggs are especially rich in protein (the nitrogenous ingredient of food). This material is required by man to build and repair the tissues of the body. Some energy is also furnished by protein, but fats and carbohydrates supply the greater part of the total amount needed. Combining eggs with flour and sugar (carbohydrates) and butter, cream, etc. (fat), is perhaps an unconscious effort to prepare a food which shall more nearly meet the requirements of the body than either ingredient alone. When eggs, meat, fish, cheese or other similar foods rich in protein are eaten, such other foods as bread, butter, potatoes, etc., are usually served at the same time, the object being, even if the fact is not realized, to combine the different classes of nutrients into a suitable diet. The wisdom of such combination, as well as of other generally accepted food habits, was proved long ago by practical experience. The reason has been more slowly learned.

As previously stated, egg white when heated at the temperature of boiling water for a considerable time becomes hard and contracts. This explains the curdling of custards, shrinkage and toughening of omelets, souffles, meringues, sponge cake and similar mixtures. The firm coagulation of albumen at 212° F. explains the use of egg white for clarifying coffee, soup or other liquids. The albumen, which is mixed with the liquid before boiling coagulates and incloses the floating particles, leaving the liquor clear. When eggs are removed from the shell, a little of the white usually clings to the inner surface unless it is scraped. Such eggshells are often used for clarifying purposes instead of the whole egg. The clarifying properties are, of course, due to the egg white and not to the shells.

The uses of eggs for other purposes than food are numerous. Large quantities of egg white are used in the manufacture of albumen paper for photographic purposes, and the egg white and yolk, and products made from them, are very important in the manufacture of many different articles.

DESCRIPTION AND COMPOSITION OF EGGS.

Size.—The eggs of different kinds of domestic poultry vary in size as well as appearance, and there is also a considerable range in the size of eggs of different breeds; thus, hens' eggs rang from the small ones laid by bantams to the large ones laid b ysuch breeds as Light Brahmas. On an average a hen's egg is 2.27 inches in length and 1.72 inches in diameter or width at the broadest point, and weighs about 2 ounces, or 8 eggs to the pound (1.5 pounds per dozen). Generally speaking, the eggs of pullets are smaller than those of old hens, those of ducks somewhat larger than hens' eggs, while those of turkeys and geese are considerably larger. Guinea eggs, on an average, measure 1.87 by 1.5 inches, are rather pointed at one end, and weigh about 1.4 ounces each, or 17 ounces to the dozen. Goose eggs weigh about 5.5 to 6.7 ounces each, or about 5 pounds to the dozen—that is, more than three times as much as hens' eggs. The eggs of wild birds are said to be smaller than those of the same species when domesticated. Wild ducks' eggs are said to be, on an average, 1.97 to 2.17 inches in diameter, and domestic ducks' eggs 2.36 to 2.56 inches.

Composition.—The shells of hens' eggs constitute about 11 per cent., the yolk 32 per cent. and the white 57 per cent. of the total weight of the egg. The proportion of white and yolk varies somewhat with different breeds. According to recent investigations the proportion of yolk is greatest in bantam eggs, and in general is greater with those breeds of poultry which are best suited for fattening than with other breeds. As shown by tests made at the New York State Experiment Station, white-shelled eggs have a somewhat heavier shell than brown-shelled eggs. The shell of a duck's egg constitutes about 14 per cent. of the total weight, and that of a plover egg 10 per cent. The following table shows the composition of hens' eggs, raw and cooked, brown shelled and white shelled, and of egg white and yolk, as well as the composition of the egg (whole egg white and yolk) of the guinea fowl, duck,

goose, turkey, plover, etc., also evaporated eggs and egg substitutes. For purpose of comparison, the composition of beefsteak and several other familiar animal foods and of wheat flour and potatoes, is also added.

AVERAGE COMPOSITION OF EGGS, EGG PRODUCTS, AND CERTAIN OTHER FOODS.

	Refuse	Water	Protein	Fat	Carbo-hydrates	Ash	Fuel val. per pound
Hen:	P.ct.	P.ct.	P.ct.	P.ct.	P.ct.	P.ct.	C'l'r's
Whole egg as purchased	11.2	65.5	11.9	9.3	.....	0.9	635
Whole egg, edible port'n	....	73.7	13.4	10.5	.....	1.0	720
White	....	86.2	12.3	.2	.....	.6	250
Yolk	....	49.5	15.7	33.3	.....	1.1	1,705
Whole egg boiled, edible portion	....	73.3	13.2	12.0	.....	.8	765
White-shelled eggs as purchased	10.7	65.6	11.8	10.8	.....	.6	675
Brown-shelled eggs as purchased	10.9	64.8	11.9	11.2	.....	.7	695
Duck:							
Whole egg as purchased	13.7	60.8	12.1	12.5	.....	.8	750
Whole egg, edible port'n	....	70.5	13.3	14.5	.....	1.0	860
White	.....	87.0	11.1	.03	.....	.8	210
Yolk	.....	45.8	16.8	36.2	.....	1.2	1,840
Goose:							
Whole egg as purchased	14.2	59.7	12.9	12.3	.....	.9	760
Whole egg, edible port'n	....	69.5	13.8	14.4	.....	1.0	865
White	....	86.3	11.6	.02	.....	.8	215
Yolk	....	44.1	17.3	36.2	.....	1.3	1,850
Turkey:							
Whole egg as purchased	13.8	63.5	12.2	9.7	.....	.8	635
Whole egg, edible port'n	....	73.7	13.4	11.2	.....	.9	720
White	....	86.7	11.5	.03	.....	.8	215
Yolk	....	48.3	17.4	32.9	.....	1.2	1,710
Guinea fowl:							
Whole egg as purchased	16.9	60.5	11.9	9.9	.....	.8	640
Whole egg, edible port'n	....	72.8	13.5	12.0	.....	.9	755
White	....	86.6	11.6	.03	.....	.8	215
Yolk	....	49.7	16.7	31.8	.....	1.2	1,655
Plover:							
Whole egg as purchased	9.6	67.3	9.7	10.6	.....	.9	625
Whole egg, edible port'n	....	74.4	10.7	11.7	.....	1.0	695
Fresh water turtle eggs	....	65.0	18.1	11.1	.....	2.9	778
Sea turtle eggs	....	76.4	18.8	9.8	.....	.4	738
Salted duck eggs	....	68.0	12.0	9.2	.....	4.0	590
Evaporated hens' eggs:							
Whole egg	....	6.4	46.9	36.0	7.1	3.6	2,525
White	....	11.7	73.2	.3	8.6	6.2	1,501
Yolk	....	5.9	33.3	51.6	5.7	3.5	2,794
Egg substitute	....	11.4	73.9	.3	5.3	9.1	1,480
Pudding (cust'd) powd'r	....	13.0	2.1	3.4	80.9	.6	1,690
Cheese as purchased	....	34.2	25.9	33.7	2.4	3.8	1,950
Sirloin steak as purch's'd	12.8	54.0	16.5	16.1	....	.9	985
Sirloin steak, edible port'n	....	61.9	18.9	18.5	....	1.0	1,130
Milk	....	87.0	3.3	4.0	5.0	.7	325
Oysters in shell as purchased	81.4	16.1	1.2	.2	.7	.4	45
Oysters, edible portion	....	86.9	6.2	1.2	3.7	2.0	235
Wheat flour	....	12.0	11.4	1.0	75.1	.5	1,650
Potatoes as purchased	20.0	62.6	1.8	.1	14.7	.8	310
Potatoes, edible portion	....	78.3	2.2	.1	18.4	1.0	385

The above figures represent average values. Individual specimens vary more or less from the average.

As is shown by analysis, eggs consist chiefly of two nutrients—protein and fat—in addition to water and mineral matter or ash. Carbohydrates are present in small amounts and are usually not determined in analyses. According to recent figures, duck eggs contain 0.3 per cent., hens' eggs 0.67 per cent., turkey and guinea eggs each 0.8 per cent., and goose eggs 1.3 per cent. of carbohydrates. Plover eggs contain considerably more, the amount reported being over 2 per cent. In the case of domestic poultry about one-third of the carbohydrates occurs in the yolk and about two-thirds in the white of the egg. The protein or nitrogenous matter is the nutrient which is needed to build and repair body tissue, as already stated, while the fat is useful for supplying energy. Some energy is also derived from protein. Mineral matter is required by the body for building bones and other tissue and for other purposes, but less is definitely known concerning the kind and amount required than in the case of the other constituents.

In composition, eggs of all sorts resemble such animal foods as meat, milk and cheese, more than such vegetable foods as flour and potatoes. As will be seen by the figures in the above table, hens' eggs and those of other domestic fowls do not differ greatly in composition. Neither does the cooked egg vary materially in composition from the raw, though it varies markedly in texture. The yolk and white differ greatly in composition. The yolk contains considerable fat and ash, while the white is practically free from fat and has a very small ash content. The white contains somewhat less protein and about twice as much water as the yolk. As is usually the case with our familiar foods, the water is not visible as such, but is combined or mingled with the other constituents, so that the whole food is more or less moist, liquid, or juicy.

The figures quoted in the table show that there is practically no difference in composition between hens' eggs with dark shells and those with white shells, although there is a popular belief in some localities that the former are "richer."

As shown by their composition, eggs are nutritious food. They are less concentrated—i. e., contain more water—than cheese, but are more concentrated than milk or oysters. In water content they do not differ greatly from the average value for lean meat. The kinds and amounts of nutrients in eggs indicate that they may be properly used in the diet in the same way as most other animal foods, and this belief is confirmed by the experience of uncounted generations.

The table shows the nutrients in different kinds of eggs and in a few other foods. Many studies have been made of the chemical bodies making up the different classes of nutrients. Egg white is sometimes said to be pure albumen. In reality it consists of several albumens, and, according to many observers, a little carbohydrate material. The phosphorus in the albumen of the egg white is equivalent to about 0.03 per cent. phosphoric acid. The chief ash constituent is sodium chlorid (common salt).

A very extended investigation of the white of egg was made at the Connecticut State Experiment Station. The "albumen" or protein of egg white was found to consist of four bodies—ovalbume, coalbumen, ovomucin, and ovomucoid. The ovalbumen is the chief constituent and makes up the greater part of the egg white. The conalbumen has much the same chemical properties as ovalbumen, Ovomucin and ovomucoid are glycoproteids, and are present in small amounts.

Egg yolk contains a number of different bodies, including about 15 per cent. vitellin (a proteid); 20 per cent. palmatin, stearin, and olein (the fatty constituents), and 0.5 per cent. coloring matter, besides some lecithin (a fat-like body containing phosphorus), nuclein, etc. The yellow coloring matter in egg yolk has been separated and studied somewhat, and though its exact character is not yet known, it is related to the yellow coloring matter of animal origin called lutein. The total phosphorus in the yolk is equivalent to a little over 1 per cent. of phosphoric acid. Besides phosphorus, the yolk contains such chemical elements as calcium, magnesium, potassium, and iron in the form of salts and other chemical compounds. The protein of egg yolk was studied extensively at the Connecticut State Experiment Station. According to these investigations it contains a large amount of proteid matter combined with lecithin. The name lecithin-nucleo-vitellin is proposed for this compound, which behaves like a globulin. It is soluble in a solution of salt. As prepared in the laboratory, the lecithin-nucleo-vitellin contained from 15 to 30 per cent. lecithin. A lecithin-free body insoluble in salt solution was also isolated. This was called nucleo-vitellin.

The lecithin present in egg yolk and other food materials has come to be regarded as one of the very im-

portant food constituents, as, in addition to other elements, it furnishes the body with phosphorus in a form in which it may be readily assimilated. Eggs have always been recognized as a valuable food in invalid dietetics. The investigations which have been made with lecithin furnish additional proof of the truth of this belief, and egg yolks in abundance are often prescribed where it is desirable to supply a very nutritious and easily assimilated diet.

One of the constituents of egg albumen is sulphur, and the egg albumen is readily decomposed with the liberation of hydrogen sulphid. The bad odor of rotten eggs is due largely to the presence of this gas and phosphureted hydrogen, which is also formed. The shell of the egg is porous, and the micro-organisms which cause the egg to ferment—i. e., to rot, or spoil—gain access to the egg through the minute openings. Like the mold spores, these micro-organisms are widely distributed.

Composition of shell.—In the table no figures are given for the composition of the eggshell, which, of course, has no food value. The shell of the hen's egg is made up very largely of mineral matter, containing 93.7 per cent. calcium carbonate, 1.3 per cent. magnesium carbonate, 0.8 per cent. calcium phosphate, and 4.2 per cent. of organic matter. The shells of goose eggs, on an average, have the following percentage composition: Calcium carbonate, 95.3; magnesium carbonate, 0.7; calcium phosphate, 0.5, and organic matter, 3.5. The shells of ducks' eggs contain 94.4 per cent. calcium carbonate, 0.5 per cent. magnesium carbonate, 0.8 per cent. calcium phosphate, and 4.3 per cent. organic matter. The shells of other eggs are doubtless of much the same composition.

FLAVOR OF EGGS.

It is generally conceded that eggs which are perfectly fresh have the finest flavor. After eggs have been kept for a time the flavor deteriorates, even if there is no indication of spoiling. Such differences are especially important when eggs are used for table purposes. Stale eggs are not regarded as palatable, and the flavor of spoiled eggs is such that for this, if for no other reason, they are totally unfit for food. The flavor of even perfectly fresh eggs is not always satisfactory, since it is influenced more or less by the character of the food eaten by the laying hens. The New York State Experiment Station studied the effect of different rations upon the flavor of eggs. Those laid by hens fed a highly nitrogenous ration were inferior to those from hens fed a carbonaceous ration. They had a disagreeable flavor and odor, the eggs and yolk were smaller, and the keeping qualities were inferior. In a test at the Massachusetts (Hatch) Experiment Station to compare cabbage and clover rowen as the green portion of a ration for laying hens, it was found that the eggs produced on the former ration, although heavier and possessing a higher percentage of dry matter, protein, and fat, were inferior in flavor and cooking qualities to eggs produced on the ration containing clover. The North Carolina Experiment Station studied the effect of highly flavored food upon the eggs produced. A small quantity of chopped wild-onion tops and bulbs was added to the feed of a number of hens. After about two weeks the onion flavor was noticed in the eggs laid. When the amount of onion feed was increased the flavor became so pronounced that the eggs could not be used. A week after the feeding of onions was discontinued the disagreeable flavor was no longer noticed. From these tests it appears that the flavor of eggs may be materially influenced by the food consumed. This is a matter of importance, especially when poultry are kept to supply eggs for table use.

COLOR OF EGGSHELLS.

Considering both wild and domestic birds of all sorts, the eggshell ranges from white to deep colors through a variety of tints and mottlings. The eggs of domestic fowls are not highly colored. Those of hens vary from white to a light or deep brownish tint, the eggs from a particular breed being very similar as regards their color. The eggs of ducks are bluish white, those of geese are commonly white. The eggs of guinea fowls are white or light brown more or less mottled with a deeper shade, and the eggs of turkeys are usually speckled with a yellowish brown.

Any special coloring of eggs of wild birds is commonly explained as a protective measure which has been developed to render the eggs inconspicuous in their normal surroundings, and therefore less easily found by their enemies. Such reasonings would indicate that the observed differences in the color of hens' eggs are due to characteristics which different breeds have inherited from remote wild ancestors. Of common breeds, Plymouth Rocks, Wyandottes, Cochins, Brahmas and Langshans, among others, lay brown-shelled eggs, and Leghorns and Minorcas white-shelled eggs.

In studies undertaken at the Maine Experiment Station with Wyandottes and Plymouth Rocks for the purpose of establishing strains with highly developed laying qualities the recorded data show that although both breeds lay tinted eggs the depth of color varies decidedly with the individual birds in the case of each breed. By careful selection of breeding stock, therefore, it should be possible to control the color of the eggshell to a great extent so that it may be made to meet any market demand. The color of the shells, whatever its reason, is a feature which has some effect on the market value of eggs of domestic poultry, although not upon their food value, the brown-shelled eggs bringing the higher price, for instance, in the Boston market and white-shelled eggs in the New York market. In England the preference is decidedly in favor of the tinted eggs.

There is no constant relation between the color of the shell and the composition of the egg, notwithstanding the popular belief that the dark-shelled eggs are "richer." Extended investigations, in which many analyses were made of eggs from different kinds of hens, carried on at the California and Michigan experiment stations, showed plainly that there are no uniform variations in the physical properties and chemical composition of brown-shelled and white-shelled eggs. The brown-shelled eggs analyzed at the California Experiment Station were laid by Partridge Cochins, Dark Brahmas, Black Langshans, Wyandottes and Barred Plymouth Rocks, and the white-shelled eggs by Brown Leghorns, Buff Leghorns, White Minorcas and Black Minorcas. On an average the different colored eggs were practically alike as regards composition and total nutritive value. The analyses made in connection with the Michigan Experiment Station investigations gave results which were entirely in accord with those obtained in California.

These tests and others like them justify the statement that the eggs of any given breed of hens, whatever the color of the shells, are as nutritious as those of another breed provided the eggs are of he same size and freshness and the fowls are equally well fed.

COLOR OF EGG CONTENTS.

Raw egg white has a more or less greenish tinge, though apparently no specific coloring matter has been

isolated from it. When the albumen is coagulated by heat in cooking the color varies from white to pale greenish or yellowish tones, hard to define, yet distinct.

The egg yolk owes its characteristic yellow color to a pigment closely akin to the yellow coloring matter of animal origin called lutein. Though frequently the yolk is pale, the color which we associate with the egg yolk is a decided yellow. The pale-yolked eggs are often said by housekeepers to be inferior, as a given number of such yolks impart to cake or custard less of the yellow color which is looked upon as an indication of richness than do eggs of a darker yolk.

The yellow color apparently depends, in a large measure, at least, upon the presence of green feed in the ration, and pale-colored yolks indicate that such feed is deficient. At any rate, at the New York State Experiment Station, it was noted that hens fed only on certain grain and animal feeds generally laid eggs with pale yolks and that adding to the ration a liberal amount of fresh or dried young clover, alfalfa, or grass will, as a rule, insure the deeper yellow color, which is desired. It is reasonable to assume that it is the coloring bodies or other materials containing iron present in green feed which affect the yellow color of the egg yolk. The New York experiments indicate that the poultry raiser who desires eggs with deeper colored yolks can obtain them by feeding an abundance of such green feeds as those indicated.

That the color of the white varies more or less with different rations was also noted at the New York State Experiment Station, though the variation was less constant than with the yolks. There is a belief that the cooked whites of eggs having shells of light tint will match in color and that the albumen of white-shelled eggs is decidedly whiter when cooked than that of eggs with tinted shells. Perhaps few persons carry preferences so far as to refuse an egg because of the color of the white, yet it is stated on good authority that in high-class hotels and restaurants, where great attention is paid to details, it has been found that the boiled eggs served must match in color. If, when taken from the shell, one is greenish white and the other clear white the egsg are often rejected on the ground that one of them is not of the required standard of excellence.

Although analyses show, as has been stated above, that variations in color are not accompanied by corresponding variations in composition, it is not at all unlikely that there are differences in the flavor corresponding to the color of the egg contents and that the deep yellow yolks have a more pronounced flavor than the pale yolks. At any rate, as long as preferences for deep-colored yolks and clear whites exist the poultry raiser who caters to a fancy market should take them into account.

It is a matter of common observation that when eggs are boiled the yolks where it joins the white has often a more or less greenish color. Contact with the white renders the surface of th eyolk somewhat alkaline. Experiment has shown that when egg white and many other proteids are heated hydrogen sulphid or some other volatile sulfur body is quite commonly liberated in small amounts, and Rubner has found that the discoloration of of the egg yolk is due to the action, in the presence of alkali, of hydrogen sulphid thus produced on the iron of the vitellin of egg yolk.

Silver is very quickly turned dark by air containing sulfur fumes. The blackening of silver forks and spoons, so commonly noted when they come in contact with eggs at table, is due to the action upon the silver of the small amount of hydrogen sulphid or other sulfur body liberated from the egg white when it is cooked.

DIGESTIBILITY OF EGGS.

Raw eggs or eggs only slightly cooked are commonly said to be very digestible, the idea being obviously that they digest readily without giving rise to pain or other physical discomfort. The term digestibility has another meaning, and one which is commonly intended when it is used in the discussion of food values. This refers to the thoroughness of digestion—that is, to the total amount of material which any food gives up to the body in its passage through the digestive tract. Since only soluble or possibly emulsified matter can pass through the walls of the stomach and intestines and be taken up into the circulation to nourish the body, it follows that only material which is soluble or is rendered soluble by the action of pepsin, trypsin and other ferments in the digestive juices, is truly digestible. The original condition of food, the method of cooking, and the amount eaten at a given time, are among the factors which determine the quantity of any given material which can be digested.

Statements are frequently made with regard to the length of time required to digest different foods. Many of these are, doubtless, far from accurate, as the subject is not easy to study. By methods of artificial digestion the length of time required to render different foods soluble has been frequently tested. It is possible to use in the experiments the same digestive ferments which occur in the body and to approximate body temperature, etc., but it is quite certain that all the conditions of digestibility in the body cannot be reproduced in the laboratory. The results obtained are interesting and often valuable, but it is worthy of note that careful investigators are much slower to make sweeping deductions from them than are popular writers on the subject.

More than fifty years ago Dr. Beaumont, a United States army surgeon, had an excellent opportunity for studying digestibility in the stomach. A healthy young man was accidentally wounded in the stomach by the discharge of a musket. In time the large wound healed, leaving a permanent opening into the stomach. This was ordinarily closed by a valvular flap made by a fold of the stomach lining, which could be easily pushed aside and the interior of the stomach examined or the stomach contents removed as desired. Strange as it may seem, this could be done without giving the subject pain or annoyance, nor was his general health abnormal after the wound had healed in this curious way. For many years after the time of the accident (1822) the man was under Dr. Beaumont's care and observation. Very many experiments were made on the length of time required by different foods for digestion in the stomach, or "chymification." Many artificial digestion experiments were also made, using gastric juice removed from the man's stomach. Although these investigations were carried on long before the theories and methods of physiological chemistry now accepted were known, so much care was taken in making the experiments and in recording the experimental data that the work has never ceased to be of great value as well as interest. However, it should not be forgotten that Dr. Beaumont studied only digestion in the stomach; his work throws no light on digestion in the intestines. This is of especial importance in the case of starchy foods, as the digestion of starch, which is begun by the saliva, ceases in the stomach, but is resumed in the intestines. The experiments reported include among others tests of the length of time required to digest eggs, hard and soft boiled, fried, roasted and raw. The raw eggs were sometimes whipped and sometimes not. In all the tests fresh eggs were used. Hard-boiled and fried eggs each required 3½ hours for digestion in the stomach, i. e., for the formation of chyme; soft-

boiled eggs required 3 hours; roasted eggs, 2¼ hours; raw eggs, not whipped, 2 hours, and raw eggs, whipped, 1½ hours. When tested by the methods of artificial digestion followed by Dr. Beaumont, which approximated bodily conditions as closely as he was able to make them, the hard-boiled eggs required 8 hours for digestion; soft-boiled eggs, 6½ hours; raw eggs, not whipped, 4½ hours, and raw eggs, whipped, 4 hours. The two methods gave results which agree in the relative length of time required for the digestibility of the different samples, though not in the actual time required. Similar results were obtained by the two methods with the greater part of the large number of foods studied. One of Dr. Beaumont's general deductions was that most of the common foods required from 2 to 4 hours to digest in the stomach. He says, further:

"The time required for the digestion of food is various, depending upon the quantity and quality of the food, state of the stomach, etc., but the time ordinarily required for the disposal of a moderate meal of the fibrous parts of meat, white bread, etc., is from 3 to 3½ hours."

As regards the time required for digestion in the stomach, it will be seen that in this investigation eggs compare favorably with other common foods. It must be remembered that digestion continues in the intestines, and that no data are furnished by these experiments for judging of this factor. This is an important matter, as food material which escapes digestion in the stomach may be thoroughly digested later in the intestines. This fact seems to have been often overlooked in the discussion of Dr. Beaumont's work.

Some German investigations which have to do with the length of time different foods remain in the stomach have also shown that two eggs eaten raw, poached or in the form of an omelet, leave the stomach in 2 to 3 hours, being included in the same class as milk, oysters, white bread, etc. The ordinary kinds of fresh meat leave the stomach in 3 to 4 hours, and some smoked meats and salt fish in 4 to 5 hours. Another investigator, who has divided common foods into four classes according to the ease with which they are digested, includes raw or soft-cooked eggs in the most digestible class, along with beef tea, milk, etc. Few investigations have been reported regarding the comparative digestibility of the different parts of the egg. On the basis of a number of experiments, Stern concludes that raw or half-raw egg yolk is very readily digested. He found that two to four raw yolks leave the stomach in 70 to 100 minutes, and that one or two yolks taken in a cup of hot coffee with some sugar and milk leave the stomach in 60 to 70 minutes.

Among later experiments on the digestibility of eggs by artificial methods, the work of the Minnesota Experiment Station may be cited. The object was to study the thoroughness as well as the ease of digestion. Five experiments were made by means of a pepsin solution with eggs cooked under different conditions. Eggs were cooked for 3 minutes in water at 212° F., giving a "soft-boiled" egg, and for 5 minutes and 20 minutes at the same temperature. The egg boiled 3 minutes and digested for 5 hours in pepsin solution, compared with one boiled 20 minutes and treated in the same way, showed 8.3 per cent. undigested protein in the former, against 4.1 per cent. undigested protein in the latter. Under similar treatment the egg boiled 5 minutes gave 3.9 per cent. undigested protein. In all cases the egg was quite thoroughly digested. Another trial was then made in which the eggs were cooked for periods of 5 and 10 minutes in water at 180° F.—that is, the albumen was coagulated at a lower temperature than that of boiling water. In both of these cases the protein was entirely digested in 5 hours. These results would indicate that while the time and the temperature of cooking have some effect upon the rate of digestion, they do not very materially affect the total digestibility.

As regards the general deduction that eggs cooked for different lengths of time vary somewhat in the length of time for digestion, under the experimental conditions the results agree quite closely with those obtained by Dr. Beaumont.

Experiments have also been made with man to learn how thoroughly eggs are digested. In such tests it is usual to analyze the food and the feces, the latter being assumed to consist principally of undigested food. Deducting the amount of the different nutrients in the feces from the total amount consumed, shows how much of each nutrient was digested. Such an experiment was made at the Minnesota Experiment Station with a healthy man. A very considerable portion of the nitrogenous material and fat of the ration was furnished by eggs, the other foods eaten being potatoes, milk and cream. About 90 per cent. of the total nitrogenous material and over 90 per cent. of the fat consumed were digested. In experiments at the University of Tennessee, with healthy men on a diet of bread, milk and eggs, from 93 to 95 per cent. of both the protein and fat was digested. The conclusion, therefore, seems warranted that, as shown by composition and digestibility, eggs possess the high nutritive properties which are Discussing these tests, Rubner says in effect:

A German investigator, Rubner, some years ago tested the digestibility of hard-boiled eggs with a healthy man. No other food was eaten with the eggs. It was found that 95 per cent. of the total dry matter and 97 per cent. of the protein were digested. The fat was also very thoroughly assimilated. The percentage of total dry matter and protein digested was about the same as was found in similar experiments in which meat only was eaten, while the percentage of fat digested was larger. Discussing the tests, Rubner says in effect:

"From the fact that eggs are as completely digested as meat, it does not follow that they are digested in the same time, or that hard-boiled eggs do not produce more disturbance in the digestive organs. It is highly probable that there is no difference in the thoroughness of digestion of hard-boiled and soft-boiled eggs."

Jorissenne, discussing the digestibility of eggs with reference to some recent European work on the subject, states that he regards the yolk of raw, soft-boiled and hard-boiled eggs as equally digestible. The white of soft-boiled eggs, being semi-liquid, offers little more resistance to the digestive juices than raw white. The white of a hard-boiled egg is not generally very thoroughly masticated. Unless finely divided, it offers more resistance to the digestive juices than the fluid or semi-fluid white, and undigested particles may remain in the digestive tract many days and decompose. From this deduction it is obvious that thorough mastication is a matter of importance. Provided mastication is thorough, marked differences in the completeness of digestion of the three sorts of eggs, in the opinion of the writer cited, will not be found.

Perhaps the most extended study of the digestibility of eggs on record was carried on at St. Petersburg by Tikhvinski. Two experiments, each divided into two periods of seven days, were made with a healthy man. In the first period of the first experiment the diet consisted of hard-boiled eggs, bread and meat; in the second, of soft-boiled eggs with bread and meat. The second experiment was made under similar conditions, ex-

cept that the soft-boiled eggs were used in the first period and the hard-boiled in the second. The eggs furnished about one-fifth of the total protein and two-thirds of the total fat of the diet. Considering the average results of the whole investigation or those of each experiment, the rations containing the eggs cooked in the two ways proved equally digestible, 90 to 91 per cent. of the protein and 95 per cent. of the fat consumed being retained in the body. As the only factor in the experiments which varied was the time of cooking the eggs, the deduction seems warranted that the hard and soft boiled were equally digestible.

Lebben reports a digestion experiment with a healthy man in which 22 eggs were consumed in ten days. In round numbers the following coefficients of digestibility were obtained: Dry matter 95, protein 98, total ether extract 96, lecithin 91, neutral fat 98, and ash 70 per cent. Stern, whose work was referred to above, concluded that egg yolks were very thoroughly assimilated, as he found only 1.5 to 3.5 per cent. of the fat of the egg yolk in the feces, a smaller proportion than was found in the case of milk fat and other animal fats. He states, further, that egg yolks stimulate gastric digestion and in addition contain a ferment which has some action upon starch.

Schilling made extended microscopical studies of the undigested material in feces from a variety of foods. He found that raw egg and egg slightly cooked, as in hot soup, was thoroughly digested. In the case of hard-boiled eggs bits of shell or skin of the egg accidentally eaten were recovered in the feces. The egg itself was apparently quite thoroughly digested. When fried egg or omelet was eaten some small bits of brown, hard-cooked egg were recovered, but in general the tests showed that the eggs were very thoroughly assimilated.

In connection with the nutrition investigations of the Department of Agriculture, the average coefficients of digestibility have been deduced for different kinds of food materials, that for the protein of eggs being 97 per cent. and for the fat 95 per cent.

From all the evidence it seems fair to conclude that eggs are quite thoroughly digested and that the length of time of cooking has less effect upon this factor than upon the time required for digestion. In a healthy man the latter consideration is probably not a matter of much importance. In the diet of sick persons and invalids it may be more important. Diet in such cases, however, is a matter for the attention of skilled physicians.

In some of the experiments referred to above the eggs were used alone; in others, as a part of a more or less simple mixed diet. The effect of one food upon the digestibility of another is a matter concerning which little is definitely known. It is possible that when two foods are eaten together the digestibility of either or both is unchanged, increased or diminished.

Apparently no experiments have been made in which the problem was studied with special reference to eggs combined with other foods. However, artificial digestion experiments were made by Fraser on the effect of beverages on the digestibility of a number of foods including raw and cooked egg albumen, which led to the deduction that tea, coffee and cocoa retarded somewhat the digestibility of the nitrogenous constituents of eggs, although the effect was less marked with coffee than with the other beverages. Water did not have this effect. Though interesting in themselves, too wide application should not be made of the results of such tests, for even if the beverages retarded digestibility somewhat, it does not necessarily follow that this effect was harmful or that the thoroughness of digestion was altered.

THE PLACE OF EGGS IN THE DIET.

Eggs are used in nearly every household in some form or another in varying amounts. From the results of the numerous dietary studies made under the auspices of the Department of Agriculture, and by the agricultural experiment stations, it has been calculated that on an average eggs furnish 3 per cent. of the total food, 5.9 per cent. of the total protein. and 4.3 per cent .of the total fat used per man per day. Cheese was found to furnish 0.4 per cent. of the total food, 1.6 per cent. of the total protein and 1.6 per cent. of the total fat, while the milk and cream together furnish 19.9 per cent. of the total food, 10.5 per cent. of the total protein and 10.7 per cent. of the total fat. Milk and cream together also furnish some carbohydrates, while eggs and cheese furnish no appreciable amount of this group of nutrients. Considering some of the common meats, beef and veal together were found to furnish 10.3 per cent. of the total food, 24.6 per cent. of the total protein and 19.5 per cent. of the total fat. The corresponding values for mutton and lamb together were 1.4, 3.3 and 3.8 per cent.

It will be seen that, judged by available statistics, eggs compared favorably with the more common animal foods as regards both the total food material and the total protein and fat furnished by them in the average daily dietary. In other words, investigations show that the high food value of eggs is appreciated and that they constitute one of the very important articles of diet in the American household.

The amount of nutritive material which a given amount of eggs will furnish at any stated price per dozen may be readily calculated. When eggs are 15 cents per dozen, 10 cents expended for this food will furnish 1 pound total food material, containing 0.13 pound protein and 0.09 pound fat, the whole having a fuel value of 635 calories. At 25 cents per dozen, 10 cents worth of eggs will furnish 0.60 pound total food material, supplying 0.08 pound of protein, 0.05 pound of fat, and 380 calories. At 35 cents per dozen, 10 cents will procure 0.43 pound total food material, containing 0.06 pound of protein, 0.04 pound of fat, and furnish 275 calories. Ten cents expended for beef at 8 cents per pound will furnish 1.25 pounds total food material, containing 0.24 pound protein, 0.16 pound fat and 1,120 calories. Expended for beef sirloin at 20 cents per pound it will furnish 0.5 pound total food matter, containing 0.08 pound protein, 0.09 pound fat and 520 calories. If wheat bread is purchased at 5 cents per pound, 10 cents will pay for 2 pounds of total food material, containing 0.18 pound protein, 0.03 pound of fat, 1.06 pounds carbohydrates and 2,430 calories.

In many of the dietary studies made in the United States data were recorded of the cost of different foods and the relative amount of nutritive material contributed by each in proportion to the total cost. Compared with other foods at the usual prices, eggs at 12 cents per dozen were found to be a cheap source of nutrients; at 16 cents per dozen they were fairly expensive, and at 25 cents per dozen and over they were very expensive. This points needs some further discussion, since the value of eggs cannot fairly be estimated solely on the basis of the amount of nutrients furnished. Eggs are also valuable for givingg variety to the diet and for furnishing a light, easily digested, nitrogenous food, especially suitable for breakfast or other light meal, an important item for those of sedentary habits.

Many families of moderate means make a practice

of buying fresh meat for but one meal a day—i. e., dinner—using for breakfast either bacon, drief beef, codfish, or left-over meats, etc., and for lunch or supper, bread and butter and the cold meat and other foods remaining from the other two meals, with perhaps the addition of cake and fresh or preserved fruit. It is the thrifty housekeeper, who uses all her material as economically as possible in some such way, who is likely to fall into the error of excluding eggs at higher prices almost entirely from her food supply. If her economy was directed principally to restraining the use of eggs in the making of rich dessert dishes, cake and pastry, one might not only refrain from criticising but welcome the circumstances which necessitated the making of simple and therefore more wholesome desserts. But usually the housekeeper economizes by the more obvious method of omitting to serve them as a meat substitute.

The statement so frequently made by housekepers that eggs at 25 cents per dozen are cheaper than meat is true in one sense. Not, of course, with reference to the total amount of nutrients obtained for the money expended, but because a smaller amount of money is needed to furnish the meal. That is to say, whereas at least 1.25 pounds of beefsteak, costing 25 cents per pound, would be necessary to serve five adults, in many families five eggs, costing 10 cents, at 25 cents per dozen, would serve the same number and probably satisfy them equally well. If the appetites of the family are such as to demand two eggs per person, doubling the cost, it is still 20 per cent. less than the steak. Many persons eat more than two eggs at a meal, but the average number per person it is believed does not generally exceed two in most families. A hotel chef is authority for the statement that at least one-half the orders he receives are for one egg. Frequently when omelets, souffles, creamed eggs, and other similar dishes are served in place of meat or fried, poached or boiled eggs, less than one egg per person is used.

These statements must not be understood as advocating a free use of eggs at any price, but merely as pointing out that even at the higher prices the occasional use of eggs in place of meat need not be regarded as a luxury. This is illustrated by observations made by Miss Bevier and Miss Sprague at Lake Erie College, Ohio, during a dietary study of some 115 women, most of them students. It was found that the amount and cost of certain foods required for a single meal, when any one of them was served, was as follows:

COMPARATIVE AMOUNT AND COST OF CERTAIN FOODS REQUIRED, PER MEAL, BY WOMEN STUDENTS' CLUB.

	Amount required.	Price per pound.	Total cost per meal.
	Pounds	Cents	
Beefsteak	36	17	$6.12
Mutton chops	45	14	6.30
Hamburg steak	24	12½	3.00
Sausage	30	12	3.60
Bacon	12	9	1.08
Dried beef	4	23	.92
Eggs	15	14⅔	2.20
Eggs	15	16⅔	2.50

At the price at which board was furnished steaks and chops were too expensive for use as breakfast dishes. Bacon or dried beef was considered cheap. Hamburg steak and sausage were regarded as practicable and were occasionally used. When the investigation was undertaken, the opinion was commonly held that eggs at 22 cents per dozen were expensive, and at 25 cents per dozen so dear that they could not be used, yet it will be seen by reference to the above table that at both prices the amount of eggs actually required to satisfy the members of the club cost less than any of the foods except bacon and dried beef. Observation showed that many of the students did not care for Hamburg steak or sausage and would eat eggs. If any boiled eggs were left they could be used for garnishing salads or in other ways, and therefore need not be wasted, while it was difficult to utilize the remnants of Hamburg steak or sausage in such a way that they were relished. It appears, therefore, that as regards both economy and palatability, the use of eggs in this case as a breakfast dish was warranted.

In the instance cited it is known that 10 dozen eggs, 30 pounds of sausage, 24 pounds of Hamburg steak, 12 pounds of bacon, and the amounts of the other foods mentioned in the table were not equivalent as regards the quantity of nutrients furnished, although any of the foods could be used as a breakfast dish in the quantity mentioned and give satisfaction to the club. It must be remembered, however, that other foods were served with the meat or eggs, and that the total amount of nutrients consumed at the meal may not have varied greatly from day to day, although the menu was quite different. Furthermore, physiologists believe that the quantities eaten each day need not conform exactly to the accepted dietary standard, but rather that the daily average throughout a considerable period must not vary very greatly from it. A deficiency on one day may be easily made good by an abundance the next. When, as was the case at Lake Erie College, each meal is abundant, the average daily diet corresponds with reasonable closeness to the commonly accepted dietary standard, and the persons consuming it have every appearance of being properly nourished, such substitutions of foods of unlike nutritive value seem justifiable on theoretical as well as on practical grounds. It hardly needs to be said that the instance cited is in accord with the ordinary household practice.

It is renerally recognized that eggs require less time for cooking than most common foods, and this may be seen from experiments carried on by the Association of Collegiate Alumni of Boston in a study of the relative cost of foods cooked with different kinds of fuel and related questions. There are undoubtedly cases in which a small saving of gas or other fuel in the preparation of a dish is of importance, but the saving of fuel would perhaps be most often less important than a saving of time. Without question a reason for the popularity of eggs in most households is that they may be so easily and quickly prepared for the table in appetizing ways.

Eggs and the foods into which they enter are favorite articles of diet with very many, if not most, families, and in this as in other cases the income and the need for economy must determine how far and in what way they are to be used when they are high in price. Judged by their composition and digestibility, eggs are worthy of the high opinion in which they are usually held. Furthermore, they are generally relished. Although the physiological reasons were perhaps difficult to find, it was long ago conceded that the attractiveness and palatability of any food must not be forgotten in considering its true nutritive value. Refinement in matters of diet should keep pace with growth in general culture, and the foods which please the esthetic sense as well as satisfy the hunger are certainly to be preferred to those which serve the latter purpose only, if they can be provided with the income at one's command.

MARKETING AND PRESERVING EGGS.

In earlier times eggs, if sold at all, were marketed near the place where they were produced. Many are still sold in local markets, but with improved methods of transportation the market has been extended and large

quantities of eggs are shipped from this country and Canada not only to distant points in America, but to England and more distant coutnries. For shipping long distances there are special egg cases, and the shipper should select the kind which is preferred in the market which he desires to reach. The way in which eggs are graded commercially naturally varies more or less in different markets, but in general the grading depends upon freshness, flavor, uniformity, size, appearance, color and similar factors. It is important that, as is the case with perfectly fresh eggs of good quality, the egg contents should almost completely fill the shell and that the egg white should be jelly-like rather than watery in consistency. It is said that these qualities are affected by the character of the rations fed, and that in the case of fowls given a well-balanced ration the shells will be well filled and the eggs of good consistency. The color of the yolk is undoubtedly a factor which influences many in their judgment of the quality of eggs. This is undoubtedly influenced by food, and it is claimed that yellow corn, especially with an abundance of green feed, tends to produce eggs with decidedly yellow yolks.

Only perfectly fresh eggs should be marketed. The shells should always be wiped clean, if necessary, and the eggs graded as regards size. In some markets brown eggs are preferred to white, as was noted elsewhere. It is stated that in the Boston market brown-shelled eggs, such as are laid by Partridge Cochins, Dark Brahmas, Barred Plymouth Rocks, etc., sell at from 2 to 5 cents per dozen more than white-shelled eggs, such as are laid by Brown Leghorns, Buff Leghorns and White and Black Minorcas. In the New York market, on the other hand, white-shelled eggs bring the higher price. That the color of the shell has no relation to the food value, as shown by analysis, is pointed out on another page. It has been found that in order to supply the demand which exists in some markets for brown-shelled eggs the shells are sometimes artificially colored.

Eggs which are to be shipped, whether with or without a special attempt at preservation, should be perfectly fresh, and should never be packed in any material which has a disagreeable odor. Musty straw or bran will injure the flavor and keeping qualities of eggs packed in it. When shipped, eggs should not be placed near anything which has a disagreeable or strong odor. Keeping eggs near a cargo of apples during transportation has been known to injure their flavor and also their market value. As previously noted, micro-organisms may enter the egg through the minute pores in the shell and set up fermentation which ruins the egg. In other words, it becomes rotten. The normal eggshell has a natural surface coating of mucilaginous matter, which hinders the entrance of these harmful organisms for a considerable time. If this coating is removed or softened by washing or otherwise, the keeping quality of the egg is much diminished. If the process of hatching has begun, the flavor of the egg is also injured.

There are many ways of testing the freshness of eggs which are more or less satisfactory. "Candling," as it is called, is one of the methods most commonly followed. The eggs are held up in a suitable device against a light. The fresh egg appears unclouded and almost translucent; if incubation has begun, a dark spot is visible, which increases in size according to the length of time incubation has continued. A rotten egg appears dark colored. Egg dealers become very expert in judging eggs by testing them by this and other methods.

The age of eggs may be approximately judged by taking advantage of the fact that as they grow old their density decreases through evaporation of moisture. According to Siebel a new-laid egg placed in a vessel of brine made in the proportion of 2 ounces of salt to 1 pint of water, will at once sink to the bottom. An egg 1 day old will sink below the surface, but not to the bottom, while one 3 days old will swim just immersed in the liquid. If more than 3 days old, the egg will float on the surface, the amount of shell exposed increasing with age; and if 2 weeks old, only a little of the shell will dip in the liquid.

The New York State Experiment Station studied the changes in the specific gravity of the eggs on keeping and found that on an average fresh eggs had a specific gravity of 1.090; after they were 10 days old, of 1.072; after 20 days, of 1.053, and after 30 days, of 1.035. The test was not continued further. The changes in specific gravity correspond to the changes in water contents. When eggs are kept they continually lose water by evaporation through the pores in the shell. After 10 days the average loss was found to be 1.60 per cent. of the total water present in the egg when perfectly fresh; after 20 days, 3.16 per cent., and after 30 days, 5 per cent. The average temperature of the room where the eggs were kept was 63.8° F. The evaporation was found to increase somewhat with increased temperature. None of the eggs used in the 30-day test spoiled.

Fresh eggs are preserved in a number of ways which may, for convenience, be grouped under two general classes: (1) Use of low temperature, i. e., cold storage; and (2) excluding the air by coating, covering or immersing the eggs, some material or solution being used which may or may not be a germicide. The two methods are often combined. The first method owes its value to the fact that micro-organisms, like larger forms of plant life, will not grow below a certain temperature, the necessary degree of cold varying with the species. So far as experiment shows, it is impossible to kill these minute plants, popularly called "bacteria" or "germs," by any degree of cold; and so, very low temperature is unnecessary for preserving eggs, even if it were not undesirable for other reasons, such as injury by freezing and increased cost. According to a report of the Canadian commission of agriculture and dairying:

"When fresh-laid eggs are put into cold storage with a sweet, pure atmosphere at a temperature of 34° F., very little, if any, change takes place in their quality. The egg cases should be fairly close to prevent circulation of air through them, which would cause evaporation of the egg contents.

"Eggs should be carried on the cars and on the steamships at a temperature of from 42° to 38°. When cases containing eggs are removed from the cold storage chamber, they should not be opened at once in an atmosphere where the temperature is warm. They should be left for two days unopened, so that the eggs may become gradually warmed to the temperature of the air in the room where they have been deposited, otherwise a condensation of moisture from the atmosphere will appear on the shell and give them the appearance of sweating. This so-called 'sweating' is not an exudation through the shell of the egg, and can be entirely prevented in the manner indicated."

It is stated by Siebel that in practice in this conutry 32° to 33° F. is regarded as the best temperature for storing eggs, although some American packers prefer 31° to 34°, while English writers recommend a temperature of 40° to 45° as being equally satisfactory. The amount of moisture in the air in the cold-storage chamber has, without doubt, an important bearing on this point. Eggs are generally placed in cold storage in April and the early part of May. If placed in storage later than this time,

they do not keep well. They are seldom kept in storage longer than a year. Eggs which have been stored at a temperature of 30° must be used soon after removal from storage while those stored at 35° to 40° will keep for a considerable time after removal from storage, and are said to have the flavor of fresh eggs. The author cited states that eggs for market, especially those designed for cold storage, should not be washed. Stored eggs should be turned at least twice a week, to prevent the yolk from adhering to the shell.

Eggs are sometimes removed from the shells and stored in bulk, usually on a commercial scale, in cans containing about 50 pounds each. The temperature recommended is about 30° F., or a little below freezing, and it is said they will keep any desired length of time. They must be used soon after they have been removed from storage and have been thawed.

The substances suggested and the methods tried for excluding air conveying micro-organisms to the egg, and for hindering the growth of those already present, are very numerous. An old domestic method is to pack the eggs in oats, bran, or salt. Another, which has always had many advocates, consists in covering the eggs with limewater which may or may not contain salt. The results obtained by such methods are not by any means uniform. Sometimes the eggs remain fresh and of good flavor, and at other times they spoil. Recently, in Germany, twenty methods of preserving eggs were tested. The eggs were kept for eight months with the following results: Those preserved in salt water, i. e., brine, were all bad, not rotten, but unpalatable, the salt having penetrated the eggs. Of the eggs preserved by wrapping in paper, 80 per cent. were bad; the same proportion of those preserved in a solution of salicylic acid and glycerin were unfit for use. Seventy per cent. of the eggs rubbed with salt were bad, and the same proportion of those preserved by packing in bran, or covered with paraffin or varnished with a solution of glycerin and salicylic acid. Of the eggs sterilized by placing in boiling water for 12 to 15 seconds, 50 per cent. were bad. One-half of those treated with a solution of alum or put in a solution of salicylic acid were also bad. Forty per cent. of the eggs varnished with water glass, collodion or shellac were spoiled. Twenty per cent. of the eggs packed in peat dust were unfit for use, the same percentage of those preserved in wood ashes, or treated with a solution of boric acid and water glass, or with a solution of permanganate of potash were also bad. Some of the eggs were varnished with vaseline; these were all good, as were those preserved in limewater or in a solution of water glass. Of the last three methods, preserving in a solution of water glass is especially recommended, since varnishing the eggs with vaseline is time consuming, and treatment with limewater sometimes communicates to the eggs a disagreeable odor and taste.

Many of these methods have been tested at the agricultural experiment stations in this and other countries. The Canada Station found that infertile eggs kept much better than fertile eggs when packed in bran. In view of the fact that preservation in brine has been said to injure the eggs by giving them an unpleasant, salty taste, experiments were recently made at Berlin University to learn the proportion of salt which entered the eggs when placed in brine of varying strength. It was found by the investigator that with a saturated or half-saturated solutions the salt entered the eggs at first very quickly and later much more slowly. After remaining 4 days in the saturated solution, an egg contained as much salt as one which remained 4 to 6 weeks in a 1 to 3 per cent. solution. If kept in the saturated solution 4 weeks, 1.1 per cent. salt was found in the yolk and 1.5 per cent. in the white of the eggs. None of the eggs tested was spoiled. When a 1 to 5 per cent. solution was used, the eggs kept well for 4 weeks and did not have a salty flavor. These instances are sufficient to show that any given method will give different results in different hands, and this is not surprising, since the eggs used are not always uniformly fresh, nor is it at all certain that other experimental conditions are uniform.

In the last two or three years the method of preserving eggs with a solution of water glass has been often tested both in a practical way and in laboratories. The North Dakota Experiment Station has been especially interested in the problem. In these experiments a 10 per cent. solution of water glass preserved eggs so effectually that "at the end of 3½ months eggs that were preserved the first part of August still appeared to be perfectly fresh. In most packed eggs, after a little time, the yolk settles to one side, and the egg is then inferior in quality. In eggs preserved for 3½ months in water glass the yolk retained its normal position in the egg, and in taste they were not to be distinguished from fresh store eggs. Again, most packed eggs will not beat up well for cake making or frosting, while eggs from a water-glass solution seemed quite equal to the average fresh eggs of the market."

Since the method was first proposed the preservation of eggs with water glass has been thoroughly tested experimentally and in a practical way in the United States and other countries, in general with favorable results. A series of comparative tests at the Canada Experimental Farms led to the conclusion that limewater was equal to water-glass solution in effectiveness and cheaper and easier to prepare, but most who have tried it experimentally seem to prefer water glass.

Water glass or soluble glass is the popular name for potassium silicate or for sodium silicate, the commercial article often being a mixture of the two. The commercial water glass is used for preserving eggs, as it is much cheaper than the chemically pure article which is required for many scientific purposes. Water glass is commonly sold in two forms, a syrup-thick liquid of about the consistency of molasses, and a powder. The thick syrup, the form perhaps most usually seen, is sometimes sold wholesale as low as 1.75 cents per pound in carboy lots. The retail price varies, though 10 cents per pound, according to the North Dakota Experiment Station, seems to be the price commonly asked. According to the results obtained at this station, a solution of the desired strength for preserving eggs may be made by dissolving 1 part of the syrup-thick water glass in 10 parts, by measure, of water. If the water-glass powder is used, less is required for a given quantity of water. Much of the water glass offered for sale is very alkaline. Such material should not be used, as the eggs preserved in it will not keep well. Only pure water should be used in making the solution, and it is best to boil it and cool it before mixing with the water glass. The solution should be carefully poured over the eggs packed in a suitable vessel, which must be clean and sweet, and if wooden kegs or barrels are used they should be thoroughly scalded before packing the eggs in them. The packed eggs should be stored in a cool place. If they are placed where it is too warm, silicate deposits on the shell and the eggs do not keep well. Only clean eggs should be packed, but the North Dakota Experiment Station found it best not to wash the eggs before packing, as this removes the natural mucilaginous coating on the outside of the shell. The station states that 1 gallon of the water glass will make sufficient solution for 50 dozen eggs if they are properly packed.

If it is desired to preserve eggs in limewater, the solu-

tion may be prepared by placing 2 or 3 pounds of unslaked lime in 5 gallons of water and allowing the mixture to stand until the lime settles and the liquid is clear. The eggs should be placed in a clean earthenware jar or other suitable vessel and covered with the clear limewater. Sometimes a pound of salt is used with the lime, but it is said that such a mixture imparts a slight taste of lime to the eggs.

It is, perhaps, too much to expect that eggs packed in any way will be just as satisfactory for table use as the fresh article. The opinion seems to be, however, that those preserved with water glass are superior to most of those preserved otherwise. The shells of eggs preserved in water glass are apt to crack in boiling. It is stated that this may be prevented by puncturing the blunt end of the egg with a pin before putting it into the water.

In tests carried on at the Washington Experiment Station water glass gave better results than limewater or a patent egg preservative. It was found that the eggs packed in water glass were not only satisfactory after having been packed for a number of months, but also when kept for four weeks after removal from the preservative solution.

In a study of the relative merits of different egg preservatives carried on by the Ontario Agricultural and Experimental Union losses in weight were recorded. When eggs were packed in salt the loss due to evaporation was equal to 33 per cent. of the contents. When the eggs were greased this was reduced to 25 per cent. No loss was noted when the eggs were preserved in water-glass solution or limewater.

In the East Indian Archipelago salted ducks' eggs are an article of diet. The new-laid eggs are packed for 2 or 3 weeks in a mixture of clay, brick dust and salt. They are eaten hard boiled. It is said that in this region and in India turtle eggs are also preserved in salt. These products, while unusual, do not necessarily suggest an unpleasant article of diet. The same can hardly be said of a Chinese product, which has often been described. Ducks' eggs are buried in the ground for 10 or 12 months and undergo a peculiar fermentation. The hydrogen sulphid formed breaks the shell and escapes while the egg becomes hard in texture. It is said that the final product does not possess a disagreeable odor or taste. Eggs treated in this or some similar way are on sale in the Chinese quarter of San Francisco, and very likely in other American cities. A sample which was examined had the appearance of an egg covered with dark-colored clay or mud.

SELLING EGGS BY WEIGHT.

Since eggs vary more or less in size it has been proposed that they should be sold by weight rather than by the dozen, which is the usual custom in this country. The North Carolina Experiment Station, in investigating this point, recorded the weight of eggs per dozen and the number produced during six months by pullets and old hens of a number of well-known breeds, and by ducks. Generally speaking, larger eggs were laid by hens than by pullets of the same breed. The eggs laid by Pekin ducks (old and young) averaged 35.6 ounces per dozen, and were heavier than those laid by any breed of hens. Of the different breeds of hens tested the largest eggs weighed 28 ounces per dozen, and were laid by Light Brahmas. The Black Langshan and Barred Plymouth Rock hens' eggs weighed a little over 26 ounces per dozen, while those laid by Single Comb Brown Leghorns, late-hatched Plymouth Rock, White Wyandotte and Buff Cochin hens ranged from 21.7 to 23.7 ounces per dozen.

Of the pullets, the heaviest eggs (weighing 26.5 ounces per dozen) were laid by the Black Minorcas, the lightest by the Single Comb Brown Leghorns and Silver-Laced Wyandottes. These weighed 17.5 and 22.1 per dozen, respectively. The Barred Plymouth Rock, White Plymouth Rock, White Wyandotte, Black Langshan and Buff Cochin pullets' eggs all weighed not far from 24 ounces per dozen. As will be seen, the variation in the weight of the eggs was considerable. In tests carried on at the Maine Experiment Station it was noticed that eggs from hens that laid the greatest number were on an average smaller in size than those from hens producing fewer eggs. The percentage of fertility was also less in the former than in the latter.

In the North Carolina test all of the eggs, regardless of size, had a local market value of 13.5 cents per dozen at the time of the investigation. If a dozen Single Comb Brown Leghorn pullets' eggs weighing 17.5 ounces were worth 13.5 cents per dozen, or 12 cents per pound, the eggs of the other breeds would be actually worth from 16.3 cents for the Single Brown Leghorn hens to 21.6 cents per dozen for the Light Brahma hens, or from 20.7 to 60 per cent. in excess of their market value. The eggs of the Pekin Ducks would be worth 26.7 cents, or 97.8 per cent. above their market value. On the basis of the results obtained, the station advocates selling eggs by the pound instead of by the dozen. It is said that the egg packers and dealers maintain that this method would increase the cost of the eggs, owing to the extra handling necessary and the consequent breakage. An apparent objection to selling eggs by weight is that they are not generally used in the household in this ay. Most recipes call for eggs by number and not by weight. There is no question that weighing the eggs would be more accurate, and recipes are occasionally met with in which this method is followed.

DESICCATED EGGS, EGG POWDERS, AND EGG SUBSTITUTES.

Different methods of evaporating or desiccating whole egg yolks and whites have been proposed and several products which claim to be thus prepared are now on the market. It is said that the egg is dried in or out of a vacuum, usually by a gentle heat or by currents of air. When placed on the market the dried egg is usually ground. Sometimes salt, sugar, or both have been used as preservatives. As will be seen by reference to the table of composition, such material is merely egg from which the bulk of the water has been removed. If the process of manufacture is such that the product is palatable and keeps well, the value of evaporated eggs under many circumstances is evident.

This material is used by bakers to some extent as being cheaper when fresh eggs are high in price. It is also used in provisioning camps and expeditions, since desiccated foods have the advantage of a higher nutritive value in proportion to their bulk than the same materials when fresh. Fresh eggs contain about 25 per cent. of dry matter. If all the water is removed in preparing evaporated eggs, 1 pound will furnish nutritive material equivalent to about 4 pounds of fresh eggs. A commercial egg product which was tested appeared to be dried egg coarsely ground. For use it was thoroughly mixed with a small quantity of water. The mixture could then be fried or made into an omelet, etc., and was found to be very palatable, closely resembling in taste the same dishes made from fresh eggs.

An egg substitute has been manufactured from skim

milk. It is said to contain the casein and albumen of the milk mixed with a little flour, and is put up in the form of a paste or powder. Such material is evidently rich in protein and, according to reports apparently reliable, is used in considerable quantities by bakers and confectioners in place of fresh eggs.

Egg substitutes have been devised which consist of mixtures of animal or vegetable fats, albumen, starch or flour, coloring matter, and some leavening powder in addition to the mineral matters similar to those found in the egg. Such products are designed to resemble eggs in composition.

Other egg substitutes have been marketed which contain little or no albumen, but apparently consist quite largely of starch, colored more or less with some yellow substance. These goods are specially recommended for making custards and puddings similar in appearance to those in which fresh eggs are used. There is no reason to suppose that such products cannot be made so that they will be perfectly wholesome. The fact must not be overlooked that in the diet they cannot replace fresh eggs, since they do not contain much nitrogenous matter or fat. As recently pointed out in one of the medical journals, this may be an important matter if such an egg substitute is used in the diet of invalids, especially if the composition of the egg substitute is not known, and it is employed with the belief that, like eggs, it contains an abundance of protein.

POSSIBLE DANGER FROM EATING EGGS.

Occasionally a person is found who is habitually made ill by eating eggs, just as there are those who cannot eat strawberries or other foods without distress. Such cases are due to some personal idiosyncrasy, showing that in reality "one man's meat is another man's poison." A satisfactory explanation of such idiosyncrasy seems to be lacking.

Overindulgence in eggs, as is the case with other foods, may induce indigestion or other bad effects. Furthermore, under certain conditions eggs may be the cause of illness by communicating some bacterial disease or some parasite. It is possible for an egg to become infected with micro-organisms, either before it is laid or after. The shell is porous, and offers not greater resistance to micro-organisms which cause disease than it does to those which cause the egg to spoil or rot. When the infected egg is eaten raw the micro-organisms, if present, are communicated to man and may cause disease. If an egg remains in a dirty nest, defiled with the micro-organisms which cause typhoid fever, carried there on the hen's feet or feathers, it is not strange if some of these bacteria occasionally penetrate the shell and the egg thus becomes a possible source of infection. Perhaps one of the most common troubles due to bacterial infection of eggs is the more or less serious illness sometimes caused by eating those which are "stale." This often resembles ptomaine poisoning, which is caused, not by micro-organisms themselves, but by the poisonous products which they elaborate from materials on which they grow.

Occasionally the eggs of worms, etc., have been found inside hens' eggs, as indeed have grains, seeds, etc. Such bodies were doubtless accidentally occluded while the white and shell were being added to the yolk in the egg gland of the fowl.

Judged by the comparatively small number of cases of infection or poisoning due to eggs reported in medical literature, the danger of disease from this source is not very great. However, in view of its possibility, it is best to keep eggs as clean as possible and thus endeavor to prevent infection. Clean poultry houses, poultry runs, and nests are important, and eggs should always be stored and marketed under sanitary conditions. The subject of handling food in a cleanly manner is too seldom thought of, and what is said of eggs in this connection applies to many other foods with even more force.

USE OF FRUIT AS FOOD

INTRODUCTION.

Edible fruits show the greatest range in form, color, and appearance and are found in almost countless varieties; yet from the botanist's standpoint all our fruits are the seed-bearing portion of the plant. The edible fruits of temperate regions fall into a few groups—stone fruits, like cherries and plums; pome fruits, like apples and pears; grapes, and berries, like strawberries, blackberries and currants. There are several products, such as muskmelons, cantaloupes and watermelons, sometimes classed as fruits and sometimes as vegetables, which, of course, would not belong to any one of these groups. Tropical fruits are not so easily classified, though the citrus family (oranges, lemons, etc.) includes many of the more common sorts.

There are a few vegetable products which are not fruits in any botanical sense, but which by common consent are included in this class of food products since their place in the diet is the same. The most common of these products is rhubarb, and there are few uses of fruit which the acid rhubarb stalk does not serve. Angelica stalks, which are candied and used for making cakes and confectionery, are much less common, though the total amount used is large. It is certainly more natural to include preserved, candied and crystallized ginger root with candied pineapple, candied cumquats and similar products than with any other class of food materials, and old-fashioned candied sweet flag root may also be mentioned in this connection.

WILD AND CULTIVATED FRUITS.

In an account of the first Virginia colony it is stated that the Indians ate wild mulberries, crabapples, and huckleberries, but nothing is said of their cultivating fruits, though they raised corn and othere vegetables. Wild fruits have been part of the diet of primitive man whenever obtainable, and no one can say with certainty when wild varieties were first cultivated, but it must have been early in the history of the race, since such fruits as apples and pears have been under cultivation so long that the varieties now grown have scarcely any resemblance to the very small, woody, inferior fruit of the wild parent. As a country becomes more thickly settled, less and less reliance can be placed on wild fruits, and the market gardener and fruit grower become of increasing importance. In the United States

strawberries, blackberries, and raspberries are examples of fruit which are still eaten both wild and cultivated, and cranberries have so recently come under cultivation that many persons still think of them as a wild fruit. Huckleberries and blueberries are practically unknown, except as they grow wild, though attempts are now being made to bring the blueberry to greater perfection under cultivation. Among little-known wild fruits elderberries and scarlet haws or thorn apples, to give them their New England name, may be mentioned. Both are used for jelly making to some extent and the former for other purposes also, but as yet neither is considered as of much importance.

It would be difficult to say why some fruits which are considered to be fairly palatable and equal to others which are generally eaten have obtained so little popularity. For instance, both wild and cultivated mulberries have long been known and prized by many, but are perhaps unknown to the majority of persons and very little used. In the same way the medlar, a fruit closely related to the apple and common enough in parts of Europe, is almost unknown in the United States, though it could be readily grown, if desired.

In some of our cultivated fruits, like the banana, seed is almost never found; in the case of others, for instance the orange, the seedless and seed-bearing varieties are both common; but in the majority of fruits seeds are present in greater or less abundance. It has been said that seedlessness is a result of long-continued cultivation, but it seems more probable that the seedless forms are due to the propagation and cultivation of natural sports without seeds. Seedless sports are by no means uncommon in wild fruits. Thus the native American persimmon is now and then found bearing seedless fruit, and such a form could be perpetuated by horticulturists, if need be. The seedless navel orange has been propagated in recent times from a seedless sport, and it seems very probable that bananas, though the wild forms are commonly full of seeds, were propagated from a seedless sport in times too remote for record. Indeed, it may be said that there is an almost universal tendency to cultivate and perpetuate varieties in which seeds are few in number or small in size, and quite naturally, since such fruits are more convenient to use and contain a higher proportion of nutritive material in a given bulk.

In general, it is true that size, yield, color, flavor, texture and chemical composition are modified by cultivation.

The commercial fruit grower, of course, desires a fruit of good appearance, having satisfactory shipping and keeping qualities, and too often the consumer is satisfied to accept a product in which such qualities predominate. Discriminating purchasers, however, will insist on good flavor, texture and cooking qualities as well, and such demands should be more often urged in order that quality may replace appearance as a standard in cultivating fruit for market.

MARKET CONDITIONS AND FRUIT SUPPLY.

The fruit market has been very greatly modified and extended by improved methods of transportation and storage. A man need not be very old to remember the time when, at least in the Northern States, bananas were a comparative rarity outside the large cities, and oranges and lemons, though common commodities, were rather high in price. In the summer there was an abundance of the common garden fruits, but in winter apples were practically the only sort which was at all plentiful. A few years have witnessed a great change, and now there is hardly a village so small that bananas and other southern fruits cannot be purchased at reasonable prices. In Europe the situation is much the same. Such quantities of bananas are now taken to England and sold at such reasonable rates that they are sometimes spoken of there as the poor man's fruit. At the present time there are a number of fruits, such as avocados or "alligator pears," mangoes and sapodillas, which are fairly well known in our large markets though seldom seen in the smaller towns. The enormous development of the fruit-growing industry in California and Florida, which includes the products of both temperate and warm regions, as well as the possibilities of supplying the northern markets with tropical fruits from Porto Rico and Hawaii, makes it probable that within a few years the avocado, the mango and other tropical fruits will be as well known as the pomelo or the pineapple.

Improvements in transportation have also materially lengthened the season of many fruits, such as strawberries, which cannot be stored for any considerable period. Florida and the Carolinas now send their berries to northern markets months before the home-grown crop can be expected and several weeks before that from tidewater Virginia or New Jersey is ripe. As an illustration of the effect of improved methods in shipping fruit, it may be mentioned that melons from the south of France, hothouse peaches from Belgium, and peaches, plums and other fruits from South Africa are now sent to our American markets in winter. The introduction or origination of new varieties of fruits also prolongs the season. As an instance may be cited the Peen-to peach, a Chinese variety, which can be successfully raised in Florida and Texas, and which is found in our northern markets in early spring, though at present at prices which clearly make it a luxury. Furthermore, improved methods of culture and transportation have extended the area planted to old and well-known varieties.

COLOR AND FLAVOR OF FRUITS.

Fruits, like leaves and flowers, owe their varied color to a number of chemical compounds, the green to chlorophyll (the characteristic coloring matter of green leaves), the yellow to xanthin bodies and other yellow pigments, and the blue and red to solutions in the cell sap of complex coloring matters which have in most cases been isolated and classified. Several coloring matters are often present in combination and give rise to the great variety of shades which different fruits present. In white fruits coloring matter is absent from the epidermis and the cells are said to be filled with air. As fruits develop, mature, and deteriorate, the coloring matters present undergo marked chemical changes, and color is one of the most common means of judging of ripeness.

Attractive color has a decided effect on market value, and the public demand varies greatly in different regions. Thus, a yellow or russet dessert apple is demanded in the French market, while in many parts of the United States the red apple has the preference. A faded, dull color is often an indication of staleness; strawberries and raspberries which have been kept too long have little of the brilliant color of freshly gathered fruit. That fruit colors in general are not very permanent is shown by the way the color deteriorates on long-continued cooking or fades when canned and preserved fruits are exposed to the light.

In preparing such fruits as plums, peaches, etc., for the table, the skin may be readily removed, without injury to the flavor, by first immersing them for a short time in boiling hot water. A silver blade should always

be used for paring apples, pears and other fruits, as if a steel knife is used the acid of the fruit acts on the iron of the knife and frequently causes a black discoloration, and there is also very commonly a noticeable metallic flavor. If pared or cut fruit is exposed to the air, it rapidly turns dark in color, owing to the action of oxydases, as some of the ferments normally present in fruits are called, upon the tannin or other readily oxidizable bodies which are also normal fruit constituents.

In the same way the brown color of the bruised spots in apples is caused by oxidation by means of the oxydases present in the fruit of the tannin in the crushed cells. Such bruised portions contain a larger proportion of starch than the rest of the apple because the tannin hinders the transformation of starch into sugar.

In investigations carried on at the Oregon Agricultural Experiment Station with a view to preventing the discoloration of evaporated fruits and vegetables it was found that treating sliced apples with a weak solution of common salt (1 to 2 per cent.) resulted in a product which was very bright and white and of better appearance than that obtained by the well-known domestic treatment with cold water. It seems probable that the Oregon method may find application in the household.

Fruits owe their flavor in considerable degree to the sugars and the malic, citric and other acids which they contain, but the flavor which is so characteristic of different kinds is almost entirely due to ethereal bodies. The amount present is often too small for determination by the usual chemical methods. However, in many cases these flavor-giving bodies have been studied and their chemical nature is known.

The flavor of strawberries has been shown to be dependent in part at least upon the presence of a volatile oil with pronounced strawberry odor which is found in small proportions in the extracted fat of the dried berries. Recent German investigators have identified the compound ethers which give bananas their characteristic flavor.

With the orange and other citrus fruits the oil found in the skin has a very characteristic odor and flavor which are always associated in our minds with the flavor of the fruit. Obviously, the small amount of these bodies of pronounced odor and flavor cannot materially modify the nutritive value of fruits, but they are of great importance in considering the place of fruit in the diet, as they are very largely responsible for its attractiveness and palatability. There is no doubt that we all eat more readily the foods which please our palate than those which are of indifferent flavor, and there is every reason to believe that the foods which please are actually digested more easily than those which do not, since they stimulate a normal and abundant production of digestive juices.

COMPOSITION OF FRUITS.

Determining the proportion of water, protein, fat, carbohydrates (nitrogen-free extract and crude fiber), and ash in fruits as in other foods furnishes a convenient basis for judging of their relative food value. It is quite common for chemists to determine, instead of their proximate constituents, the proportions of the different nitrogenous bodies present, as well as the amounts of the different sugars, etc., which in the ordinary method of analysis are grouped with the other carbohydrates.

The more detailed analyses are of great interest and value for many reasons, but with our present knowledge it seems fair to assume that the various sugars and starches, for instance, have the same nutritive value, and so a knowledge of the total quantity of these bodies present gives very satisfactory data for estimating the food value of the group. Very many analyses and studies of fruit and fruit products have been made by chemists of the agricultural experiment stations, as well as by the different bureaus of the Department of Agriculture. Table 1 summarizes a large amount of such data and shows the composition of fresh, dried and preserved fruits and fruit products, and for comparison the composition of a few other foods as well. In this table and the discussions which follow, attention has been given especially to the fruit of northern and temperate regions and no attempt has been made to summarize the considerable amount of data available regarding tropical fruits, except some which are grown in the United States or which are fairly well known at least in the larger markets. Special studies of tropical fruits have been made by the California and the Maine experiment stations, and the Bureau of Chemistry of this department has reported an extended series of investigations of such fruits and the jams and preserves made from them.

Most of the fruits and fruit products included in the table are too well known to need description. Of those which are less familiar, the avocado or "alligator pear" is a green or purple fruit not unlike an eggplant in appearance. The portion eaten is the pulp which surrounds the single large seed. In texture it is soft and somewhat like butter, and to this quality it doubtless owes the name "midshipmen's butter," given to it in the days of sailing vessels. The avocado is eaten in a variety of ways, but is most commonly served as a salad. This fruit has a delicate almost nut-like flavor, and is every year becoming more popular.

The fruits of several sorts of cactus are very commonly eaten in Mexico and other regions where cactus is abundant, and are common though less well known in New Mexico and the Southwest. Under the name of prickly pear or Indian fig fresh cactus fruits, particularly the oblong, oval, yellowish or reddish fruits of *Opuntia ficus indica*, showing here and there characteristic tufts of fine spines or bristles, are occasionally seen at certain seasons of the year in large fruit shops. Cactus fruits may be used for jam making and in similar ways. A rather hard solid preserve or "cactus cheese," which may sometimes contain nuts, is a Mexican sweetmeat.

Many varieties of the guava, a very aromatic tropical and sub-tropical fruit, are grown in the warmer regions of the United States, and its uses are so varied that it is often said the guava occupies much the same place in cookery in the Tropics as the apple in northern regions. The fresh fruit is seldom seen outside the regions where it is grown, but guava jelly and guava paste are common commercial products, and have been popular ever since the days when the West India merchantmen brought these delicacies, preserved tamarinds, and oranges and lemons to our northern markets as well as such staple goods as sugar and molasses.

The roselle or Jamaica sorrel is the fruit of a widely distributed tropical hibiscus which is grown extensively in California and Florida. The fruits somewhat resemble okra in form, are of a dark magenta color, and have an acid flavor much like that of cranberries. They are used for jams, jellies, etc.

The Surinam cherry is the fruit of a South American tropical shrub now grown to a limited extent in southern Florida and California. It is about the size and shape of an ordinary cherry, and owes its common English name to this fact. The fruit is bright red in color, and has a sharp but pleasant acid flavor. The Surinam

cherry is used for jelly making, etc., but is seldom a commercial product.

The loquat, commonly though incorrectly called the Japan plum, is grown to a considerable extent in the southern United States. The small, yellowish, plum-like fruits are almost translucent when ripe, and are covered with a downy fuzz or bloom. The pulp is soft and tender and quite tart until fully ripe. The flavor is distinct and agreeable. Loquats are used both raw and cooked, and both fresh and preserved fruits are commercial products.

The sapodilla, a tropical fruit which thrives in regions like the warmer parts of Florida, suggests a good sized russet apple in appearance, but when broken open is quite different in character, as it contains a number of rather large flat brown seeds embodied in a tender brownish white pulp. The flavor is characteristic, and to some palates suggests a combination of a pleasant mild acid with caramel or brown sugar. The sapodilla is a not uncommon commercial fruit in large fruit shops.

Perhaps no fruit of the Tropics is more often discussed than the mango, some persons being exceedingly fond of this juicy aromatic fruit, while others are as outspoken in their dislike. There are countless varieties of the mango, and many of them have a rank turpentine-like flavor and are very fibrous. These qualities are not apparent, however, in the best varieties, which are of very delicate flavor and very palatable. The fruit is cooked in a variety of ways, being a staple article of diet in the Tropics, and is also eaten fresh. Some difficulty is experienced in shipping mangoes, as the flesh is very juicy and tender, but they are occasionally found in market at least as far north as Washington, D. C.

AVERAGE COMPOSITION OF FRUITS AND FRUIT PRODUCTS.

Kind of Fruit.	Refuse.	Edible Portion.						
		Water.	Protein.	Ether Extract.	Carbohydrates.		Ash.	Fuel Value Per Pound.
					Nitrogen-Free Ext't.	Crude Fiber.		
FRESH FRUITS.	P.ct.	P.ct.	P.ct.	P.ct.	P.ct.	P.ct.	P.ct.	Cal'r's.
Apples	25.0	84.6	0.4	0.5	13.0	1.2	0.3	290
Apricots	6.0	85.0	1.1	.....	13.4		.5	270
Avocado	29.0	81.1	1.0	10.2	6.8		.9	512
Bananas	35.0	75.3	1.3	.6	21.0	1.0	.8	460
Blackberries	.....	86.3	1.3	1.0	8.4	2.5	.5	270
Cactus fruit	.....	79.2	1.4	1.3	11.7	3.7	2.7	375
Cherries	5.0	80.9	1.0	.8	16.5	.2	.6	365
Cranberries	.....	88.9	.4	.6	8.4	1.5	.2	215
Currants	.....	85.0	1.5	.....	12.8		.7	265
Currants (black)	.....	79.0	.5	.3	13.1	6.1	1.0	370
Figs	.....	79.1	1.5	.....	18.8		.6	380
Gooseberries	.....	85.6	1.0	.....	13.1		.3	255
Grapes	25.0	77.4	1.3	1.6	14.9	4.3	.5	450
Guava	.....	82.9	1.3	.7	8.0	6.6	.5	315
Huckleberries	.....	81.9	.6	.6	16.6		.3	345
Lemons	30.0	89.3	1.0	.7	7.4	1.1	.5	205
Loquat	.....	77.9	.2	.....	20.2	.6	1.1	395
Mango	40.0	87.4	.6	.4	9.9	1.2	.5	220
Medlar	.....	74.6	.5	.3	16.5	7.5	.6	455
Mulberry	.....	84.7	.4	.....	14.3		.6	280
Muskmelons	50.0	89.5	.6	.....	7.2	2.1	.6	185
Nectarines	6.6	82.9	.6	.....	15.9		.6	305
Olives	17.9	67.0	2.5	17.1	5.7	3.3	4.4	407
Oranges	27.0	86.9	.8	.2	11.6		.5	240
Peaches	18.0	89.4	.7	.1	5.8	3.6	.4	190
Pears	10.0	80.9	1.0	.5	15.7	1.5	.4	163
Persimmons	25.0	66.1	.8	.7	29.7	1.8	.9	630
Persimmons (Jap.)	24.0	80.2	1.4	.6	15.1	2.1	.6	174
Pineapples	40.0	89.3	.4	.3	9.3	.4	.3	200
Plums	5.0	78.4	1.0	.....	20.1		.5	395
Pomegranates	30.0	76.8	1.5	1.6	16.8	2.7	.6	460
Prunes	5.8	79.6	.9	.....	18.9		.6	370
Raspberries (red)	.....	85.8	1.0	.....	9.7	2.9	.6	255
Raspberries (bl'k)	.....	84.1	1.7	1.0	12.6		.6	310
Red bilberry	.....	89.6	.1	.3	3.8	6.0	.2	190
Rhubarb stalks	40.0	94.4	.6	.7	2.5	1.1	.7	105
Roselle calyx	.....	86.5	2.1	.3	10.3		.8	235
Roselle pod	.....	84.0	1.7	1.0	12.2		1.1	290
Sapodilla	40.0	77.9	.5	1.6	16.6	2.8	.6	425
Scarlet haws	20.0	75.8	2.0	.7	18.6	2.1	.8	212
Strawberries	5.0	90.4	1.0	.6	6.0	1.4	.6	180
Surinam cherry	.....	85.0	.4	.....	13.9		.7	260
Watermelons	59.4	92.4	.4	.2	6.7		.3	140
Whortleberries	.....	82.4	.7	3.0	10.3	3.2	.4	390

AVERAGE COMPOSITION OF FRUITS AND FRUIT PRODUCTS—Continued.

Kind of Fruit.	Refuse.	Edible Portion.						
		Water.	Protein.	Ether Extract.	Carbohydrates.		Ash.	Fuel Value Per Pound.
					Nitrogen-Free Ext't.	Crude Fiber.		
DRIED FRUITS.	P.ct.	P.ct.	P.ct.	P.ct.	P.ct.	P.ct.	P.ct.	Cal'r's.
Apples	.....	26.1	1.6	2.2	62.0	6.1	2.0	1,350
Apricots	.....	29.4	4.7	1.0	62.5		2.4	1,290
Bananas	.....	29.2	5.3	2.3	55.8	2.1	5.3	1,240
Banana flour	.....	9.7	3.1	.5	83.4	.7	2.6	1,610
Citrons	.....	19.0	.5	1.5	78.1		.9	1,525
Dates	10.0	15.4	2.1	2.8	74.6	3.8	1.3	1,615
Figs	.....	18.8	4.3	.3	68.0	6.2	2.4	1,475
Pears	.....	16.5	2.8	5.4	66.0	6.9	2.4	1,635
Prunes	15.0	22.3	2.1	.....	71.2	2.1	2.3	1,400
Raisins	10.0	14.6	2.6	3.3	73.6	2.5	3.4	1,605
Raspberries	.....	8.1	7.3	1.8	80.2		2.6	1,705
St. John's bread	.....	17.3	5.7	1.1	67.0	6.4	2.5	1,480
Zante currants (English c'rants)	.....	17.2	2.4	1.7	71.2	3.0	4.5	1,495
CANN'D FRUITS, PRESERVES, JELLIES, ETC.								
Crab apples	.....	42.4	.3	2.4	54.4		.5	1,120
Apple sauce	.....	61.1	.2	.8	37.2		.7	730
Apricots	.....	81.4	.9	.....	17.3		.4	340
Apricot sauce	.....	45.2	1.9	1.3	48.8		2.8	1,000
Blackberries	.....	40.0	.8	2.1	56.4		.7	1,150
Blueberries	.....	85.6	.6	.6	12.8		.4	275
Cherries	.....	77.2	1.1	.1	21.1		.5	415
Cherry jelly	.....	21.0	1.1	.....	77.2		.7	1,455
Figs, stewed	.....	56.5	1.2	0.3	40.9		1.1	785
Grape butter	.....	36.7	1.2	.1	58.5		3.5	1,115
Olives, green pickled	27.0	58.0	1.1	27.6	11.6		1.7	1,400
Olives, ripe, pickl'd	19.0	64.7	1.7	25.9	4.3		3.4	1,205
Orange marm'lade	.....	14.5	.6	.1	84.5		.3	1,585
Peaches	.....	88.1	.7	.1	10.8		.3	220
Pears	.....	81.1	.3	.3	18.0		.3	355
Pineapples	.....	61.8	.4	.7	36.4		.7	715
Prunes, stewed	.....	76.6	.5	.1	22.3		.5	430
Str'wberries, st'wd	.....	74.8	.7	.....	24.0		.5	460
Angelica stalks (candied)	.....	10.4	.1	.1	87.3	1.5	.6	1,550
Apricots (candied)	.....	14.4	.7	.1	83.0	1.1	.7	1,445
Cherries (candied)	.....	12.1	.5	.2	86.1	.5	.6	1,455
Citron (candied)	.....	18.2	.1	.1	77.6	1.0	3.0	1,380
Ginger root (candied)	.....	12.3	.3	.2	86.1	.7	.4	1,520
FRUIT PR'D'CTS.								
Olive oil	.....	.....	.....	100.0	.....	.....	.....	4,035
Raspberry juice	.....	49.3	.5	.....	49.9	.....	.3	935
Unf'rmented grape juice	.....	92.2	.2	.5	6.9	.....	.2	150
OTHER FOODS FOR COMPARISON.								
Cabbage	15.0	91.5	1.6	.3	4.5	1.1	1.0	145
Potatoes	20.0	78.3	2.2	.1	18.0	.4	1.0	385
Wheat flour, high grade	.....	12.0	11.4	1.0	74.8	.3	.5	1,650
Corn meal, bolted	.....	12.5	9.2	1.9	74.4	1.0	1.0	1,655
White bread	.....	35.3	9.2	1.3	52.6	.5	.5	1,215
Beans, dried	.....	12.6	22.5	1.8	55.2	4.4	3.5	1,605
Honey	.....	18.2	.4	.....	81.2	.....	.2	1,520
Sugar, granulated	.....	.....	.....	.....	100.0	.....	.....	1,860
Butter	.....	11.0	1.0	85.0	.....	.....	3.0	3,605

Most fruits, like other classes of foods, contain more or less material, such as pits, skin, etc., which is inedible. When such portions are removed a larger or smaller part of the edible material is almost always of necessity removed also, and is spoken of as "waste." In reporting analyses the amounts of inedible material and waste are grouped together under the heading "refuse." As may be seen from the above table, the proportion of refuse in fruits varies within rather wide limits. Thus, of pears it constitutes on an average 10 per cent. of the total fruit, peaches 18 per cent., apples and grapes 25 per cent., and bananas 35 per cent., while in the case of raspberries and blackberries there is no refuse and the whole fruit can be eaten.

The analytical data quoted above show that fresh fruits are in general dilute foods—that is, the proportion of water which they contain is large, compared with the total amount of nutritive material. It has been suggested that fruits containing 80 per cent. or more of water be classed as flavor fruits and those with less than

80 per cent. as food fruits. As may be seen from the table, such fruits as strawberries, blackberries and raspberries would be included in the first class, and fresh figs, bananas, grapes, etc., in the second. In dried fruits which have been concentrated by evaporation the percentage of nutrients is very much higher than in fresh fruits. Some preserved fruits also possess a comparatively high nutritive value, owing to the evaporation of water by the heat of cooking or to the addition of sugar, or to both factors. Candied fruits, such as cherries and apricots, which are included in the table, may be looked upon as typical examples of this class of fruit products. As regards composition, the water content is low and the carbohydrates and consequently the energy value is very high, owing to the added sugar.

Olives and the avocado are remarkable for the large percentage of fat which they contain, but in general it may be said that this constituent is present in very small proportion in fresh fruits. In the case of the apple, pear, etc., it seems probable that the small amount of fat obtained in chemical analysis consists of the coloring matter contained in the fruit or of wax found in the skin. That the amount of wax may be considerable is evident when we recall the fact that fruit wax is collected from bay berries and other fruits in quantities sufficient for candle making and other purposes. That common fruits actually contain fat, though it is not generally associated with them, is shown by a recently published study of the fat of woods strawberries. The dried berries when extracted yielded a small amount of oil, cloudy at ordinary temperatures, but clear when heated, and much like linseed oil in its properties.

In the majority of fruits and fruit products the carbohydrates are the food constituents most abundantly represented. The figures in the table show that the proportion of nitrogen-free extract varies greatly, being lowest in the fresh and highest in the dried and preserved fruits. It is interesting to consider also the values which have been reported for some of the constituents not shown in the table, but included in the group of "nitrogen-free extract." In seeds which are commonly eaten, such as the cereal grains, and beans, peas and other legumes, the nitrogen-free extract is quite largely made up of starches. In fruits, however, sugars and the so-called pectin bodies, with very often more or less starch, make up the group. The principal sugars in fruit are cane sugar, grape sugar (glucose), and fruit sugar (levulose), the last two being usually present together in equal quantity and designated invert sugar or reducing sugar. The stage of growth and the degree of ripeness have a very marked effect on the kind and amount of sugar, and it is therefore difficult to give average figures for the quantities present which will be fairly representative. An idea of the range in the sugar content of ripe fruits may be gathered from figures quoted from a summary published several years ago. According to these data, invert sugar ranged from 2 per cent. in round numbers in large early apricots to 15 per cent. in grapes and a variety of sweet cherries. A number of fruits (strawberries, gooseberries, raspberries and apples) contained about half the latter quantity. The cane sugar ranged from less than 1 per cent. in lemons to 14 per cent. in a variety of plums. Bananas also contained a fairly large percentage, namely, 11 per cent.

Fruit sugar rarely occurs unaccompanied by grape sugar, but has been thus reported in the mango and in amounts large in proportion to the grape sugar in sweet apples and sweet pears and a number of varieties of grapes. In the case of grape sugar large amounts—18 to 30 per cent.—have been reported in juice of different sorts of grapes, while in dried fruits the values are even higher, 32 per cent. having been found in prunes, 54 per cent in Zante or "English" currants, which are, of course, a small seedless grape, 61 per cent. in raisins, 48 per cent. in figs, and 66 per cent. in dates.

The acid in fruits, which in proximate analyses is not usually determined separately, varies within rather wide limits, 1 to 2 per cent. being reported on an average in such fruits as apples, pears, plums, strawberries, etc., and as high as 7 per cent. or more in lemon juice. It often happens that of two fruits with the same acid content one has a much sourer taste than the other, because the acid is not so much masked by sugar.

Fruits contain a comparatively small amount of mineral matter, less than 1 per cent. on an average—consisting quite largely of postassium salts, with a little phosphoric acid, iron, lime, etc.

As a class, it is apparent that fresh fruits are directly comparable with green vegetables and root crops rather than with more concentrated foods, such as flour or meal. The dried and some of the preserved fruits, which are more concentrated than the fresh, compare favorably with bread, dried beans and similar foods on the basis of total food material present. There is this difference, however, that the cereals and dried legumes contain fairly large proportions of protetin, while the quantity present in fruits is always small. In other words, fruits—fresh, dried and preserved—are sources of energy rather than of tissue-forming material.

Grape juice and other freshly expressed juices are pleasant and wholesome beverages. They are commonly preserved for winter use at home as well as on a commercial scale by sterilizing in bottles. The fruit jui are dilute foods, as the figures given for grape j indicate. Fruit syrups made by adding sugar to juice are extensively used in the household and in ot ways. The food value of such articles is, of course, considerably increased by the sugar which they contain.

In connection with the subject of fruit juices and syrups, it may be of interest to mention the Turkish preparation, which is made by evaporating grape juice until it is of the consistency of molasses, then thickening with flour or starch, and spreading it out to dry in the sun in thin sheets. This product is not unlike the peach leather, which is an old fashioned domestic product still made to some extent in much the same way in the southern United States by drying crushed peach pulp on platters in an oven. Plum leather is also sometimes made in the same way. After soaking in water for some hours peach leather is ready for use on the table or for making puddings, etc. Another Turkish preparation called sujuk or rojik is made by stringing walnuts on pieces of stout twine about a yard long and immersing them in a mixture of grape molasses and flour. After receiving a coating about one-fourth of an inch thick they are withdrawn and hung up to dry, and may then be preserved in jars in good condition for a few months. Sujuk is said to be an excellent article of food and palatable. Sometimes wheat grits are used to thicken the grape syrup, and the nut and syrup mixture is made in the form of cakes about one-half an inch thick when dried.

Vinegar, which contains about 3 per cent. of extractive material and 0.5 per cent. ash, in addition to 6 per cent. acetic acid and over 90 per cent. water, is one of the oldest fruit products and also one of the oldest and most common condiments and household preservatives. It owes is use in the diet to flavor and other qualities, rather than to the very small amount of nutritive material which it may contain. Honey viengar, malt vinegar, etc., are well known, but vnegar made from fruit juice is far

more common. By fermentation the sugar in the original material is converted into acetic acid, and to this the vinegar largely owes its flavor, though the salts and other materials originally present in the fruit juices have an effect upon this quality. Vinegar made from apple juice—that is, cider vinegar—has always had a reputation for good quality, though other fruit juices are of considerable importance in domestic vinegar making, banana vinegar being one of the sorts which is rather favorably known in regions where this fruit is grown. The acid juice of lemons and limes is used like vinegar as a condiment, and many persons consider that lemon juice is more delicate. It is sometimes claimed that it is more wholesome also, but this seems hardly more than a matter of opinion, as there is no reason to suppose that the small amounts of vinegar ordinarily used are in any way harmful.

Verjuice, the expressed acid juice of green apples, crab-apples, or other unripe fruit, was formerly used as a condiment and was greatly prized. It has survived in modern cookery in a limited way and may occasionally serve a useful purpose when lemon juice is not readily obtainable.

RIPENING AND ITS EFFECT ON COMPOSITION

As fruits grow to their full size and ripen they undergo marked changes in chemical composition with respect both to the total and to the relative amount of the different chemical bodies present. When stored after gathering, the changes continue, some fruits improving on storage and others deteriorating very rapidly. In general, ripe fruits are less acid than green and contain less starch, woody material, crude fiber and the carbohydrates commonly referred to as pectin bodies, and correspondingly larger amounts of the different sugars.

Fruits contain oxydases and other ferments, and these are believed to play a very important part in the chemical changes which accompany growth and maturity. Many diverse views have been expressed regarding the exact nature and extent of the processes involved and the compounds formed in ripening fruit. The question as a whole has been a favorite one with chemists, and the agricultural experiment stations have made a number of important contributions to the subject. One of the most recent and valuable contributions, both from a bibliographical and from a chemical standpoint, is the series of investigations published by Bigelow and his associates, of the Bureau of Chemistry of the Department of Agriculture, on the ripening of winter and summer apples and of peaches. With winter apples it was found that the starch increases from early summer until the maximum is reached in midsummer and then decreases and finally disappears. The malic acid content decreases from early summer until maturity, while cane sugar and invert sugar increases.

In the case of peaches, as the fruit develops from early summer to ripeness the proportion of flesh increases and the pit decreases. During this period the weight of reducing sugars increases about eight times and that of cane sugar or sucrose and acids considerably more than this. An increase is also noted with the various forms of nitrogenous substances. Throughout the whole period of growth the proportion of solids to water in the flesh of the peach remains fairly constant. The pit, on the other hand, becomes harder and the percentage of water in it decreases as growth progresses. It is interesting to note that throughout the whole period of growth no appreciable amount of starch is found in the peach. Between the condition known as market ripeness and full ripeness considerable growth takes place in the peach, there being an increase in both water and solid matter and in reducing sugar and cane sugar. A German investigator found that when black currants were picked when slightly green and kept for a few days there was an increase in the sugar and a decrease in the acid content. The changes which take place in gooseberries do not appear to be of the same character. Picked when green, they contain 3.9 per cent. sugar and 27.2 per cent. acid. When stored at a cool temperature for six days they had taken on the dark color of ripe berries and contained somewhat smaller proportions of both sugar and acid.

A knowledge of the changes which accompany the growth, ripening, and storage of fruits is very important commercially as well as from the housekeeper's standpoint. For instance, in cider making, it is desirable that the fruit should be used when the sugar content is high, as the quality of cider and vinegar is largely determined by the amount of sugar present. As every housewife knows, underripe fruit—that is, fruit which still contains the so-called pectin bodies rather than the sugars and other carbohydrates characteristic of fully ripened fruit—is the most satisfactory for jelly making. In the case of bananas the underripe fruit, rich in starch, is best for cooking, and the very ripe fruit, in which the starch has been changed into sugar, for use uncooked. It is not unlikely that failure to recognize this distinction is responsible for the digestive disturbance which many persons experience when bananas are eaten, as the raw, underripe, starchy fruits are generally conceded to be difficult of digestion. The underripe bananas, when dried, sliced and ground, yield a flour or meal rich in starch, while the riper fruit with the higher sugar content, sliced and dried, is very sweet and not unlike figs in flavor and composition.

WAYS OF SERVING FRUIT.

As regards the way in which they are served fruits range from the muskmelon, watermelon, and avocado, almost never cooked, to cranberries and the ordinary varieties of quince, which are not eaten raw. The methods of preparation are quite varied, including drying or evaporating, and baking, boiling, and stewing, while quantities of fruit are used in puddings, pies and other dishes, and for the preparation of jams, jellies and preserves. Fruit juices are used for beverages, and both fruits and the juices are very commonly prepared for the table by freezing, fruit ices being considered as among the most appetizing desserts. Some fruits, notably the green and the ripe olive and less generally the lime, are prepared for the table by pickling in brine.

Even a casual examination of cookery books and the periodical literature devoted to such topics shows that the ways in which fruits and fruit products can be cooked and served are practically endless. The housewife who desires to vary her menu by the use of more fruit and fruit dishes can do so very readily by consulting such sources of information.

The temperature at which fresh fruits are eaten is largely a matter of fashion or individual taste. With the increased use of ice in our homes during recent years it has become a very common custom to serve fruits colder than was formerly the case. Cool or even cold fruits are very refreshing and many prefer them served thus. There are others, however, who maintan that overchilling lessens the delicate flavor and accentuates the acid taste. They insist that the fruits gathered in the cool of the day and stored in a cool but not a cold place are at their best. Still others find them sweetest and most palatable when brought from the garden warmed by the sun.

PLACE OF FRUIT IN THE DIET.

In most families fruits are commonly thought of as a food accessory, and are prized for their pleasant flavor or for supposed hygienic reasons rather than for their food value; yet a study of available figures shows that they constitute a by no means unimportant part of the diet, since they supply, on the basis of recent statistics, 4.4 per cent of the total food and 3.7 per cent of the total carbohydrates of the average American diet. With a view to learning something more definite regarding the possibilities of fruits as sources of nutrients, the relative cost of nutrients supplied by fruits and other foods, the digestibility of a fruit diet as compared with an ordinary mixed diet, and related questions, extended investigations were undertaken at the California Agricultural Experiment Station by Professor M. E. Jaffa, the work as a whole being carried on in co-operation with the nutrition investigations of the Office of Experiment Stations. In the first series reported six dietary studies were made with fruitarians—two women and four children who had lived on a fruit and nut diet for several years. The dietary studies covered from twenty to twenty-eight days, and the daily food consisted of different combinations of fruits and nuts, of which the following day's ration may serve as a sample: 475 grams apples, 110 grams bananas, 850 grams oranges, 5 grams dates, 2 grams honey, 10 grams olive oil, 55 grams almonds, 70 grams pine nuts, and 50 grams walnuts.

The later studies were made with one of the women and two of the children included in the first group, and in addition with two elderly men who had been vegetarians for years and had limited their diet almost exclusively to fruits and nuts, and with two young men, university students, who were accustomed to the ordinary diet, though one of them had experimented with a vegetarian and fruitarian diet for some time. The students and one of the elder men ate three meals a day at the usual hours. The others ate but twice, the first meals being taken between 10 and 11 o'clock in the morning and the second between 5 and 6 o'clock in the afternoon. As before, the diet included a large assortment of fresh fruits, with considerable quantities of dried fruits and nuts, and some honey and olive oil. In a few cases small quantities of other foods were also eaten.

Considering these studies as a whole, the diet of the women and children furnished from 32 to 43 grams of protein and 1,190 to 1,430 calories of energy per day, the cost ranging from 15.7 to 27.5 cents. It is the usual custom to discuss dietary studies on the basis of the amounts eaten per man per day, and the results obtained with these women and children, when recalculated to this basis, showed a range of 47 to 80 grams of protein and 1,850 to 2,805 calories of energy, the cost of the daily food ranging from 21 to 55 cents per man per day. In the studies with the young and the old men the protein supplied by the daily diet ranged from 40 to 85 grams and the energy from 1,712 to 3,305 calories, the average being 62 grams protein and 2,493 calories, the cost ranging from 18.1 to 47 cents per person per day. These amounts are considerably smaller than have been found on an average with families living in many different regions of the United States and under a variety of conditions, as is shown by the fact that with 52 families in comfortable circumstances the average protein in th daily diet was 103 grams and the average energy 3,500 calories. On the other hand, in many of the dietary studies made under the auspices of the Office of Experiment Stations it has been found that persons living on a mixed diet have obtained amounts directly comparable with those supplied by the fruitarian diet. Thus, at the North Dakota Agricultural College several years ago a dietary study showed that the food consumed per man per day by a group of students furnished 64 grams protein and 2,579 calories and at Lake Erie College 68 grams protein and 2,610 calories, calculated on a uniform basis per man per day.

In an investigation carried on at Harvard it was found that the diet of nine students who lived at the college commons and, from necessity or choice, endeavored to live cheaply supplied, on an average, 89 grams protein and 3,068 calories. In this case the average cost was 39.9 cents per day and at the North Dakota and the Lake Erie colleges 13 and 18 cents, respectively. It will thus be seen that in the California investigations the fruit and nut diet supplied the subjects with amounts of protein and energy which are directly comparable with those obtained by many other persons from a mixed diet, though in general the quantities were smaller than are supplied by the diet of the average family. It should be said that the persos living on a fruit and nut diet apparently maintained their normal health and strength, and it is only fair to conclude that if, for any reason, such a course seems desirable it is perfectly possible to select a diet made up of fruits and nuts which, for long periods at any rate, will supply the body with the requisite protein and energy, as was shown by a detailed study of the results of the California experiments. In such a diet nuts were the principal sources of protein and nuts, olives or the expressed olive oil the chief source of fat, while fruits, fresh and dried, supplied the bulk of the carbohydrates.

As regards cost, it will be seen that there was a considerable range with the fruitarian diet, the amount expended per person per day being in some cases quite low and in others quite high. On the whole, the range did not differ greatly from that observed in many instances on an ordinary mixed diet.

It would seem from the recorded data that it is more difficult for the subjects to obtain the requisite amount of protein when on a limited diet of one kind of nut combined with fruits than it is when they are unrestricted and eat a variety of both fruits and nuts. In nearly all cases where the diet was limited to combinations of one or two fruits with one kind of nuts the subjects complained of a constant craving for some other food, such as green vegetables or cereals, and in these cases it was found that the coefficients of digestibility were lower than in those tests in which some vegetable or cereal was eaten, which made the diet more appetizing. The addition of a small amount of some cereal food to the diet markedly increased its protein and energy value.

It would be going too far to conclude on the basis of the California investigations that a fruitarian diet in general is equal or superior to the ordinary diet, and indeed the study of this question was not a part of the investigation. Before such a conclusion could be drawn it would be necessary to make investigations extending over a long period of years and with a variety of subjects, and which would take into account resistance to disease and other unfavorable conditions, body development, the health and condition of the offspring of persons living for years on such a diet, and other similar questions. It seems fair to say, however, that at the present time the consensus of opinion of well-informed physiologists is that the ordinary mixed diet is most convenient and satisfactory for the average individual. It is equally clear from the investigations reported that fruits and nuts should not be looked upon simply as food accessories, but should be considered a fairly economical source of nutritive material. It must be remembered, too, that the use of fruits, fresh and preserved, often makes palatable an otherwise rather taste-

less mean. Jam with our bread is a reasonable combination, the highly flavored fruit product whetting the appetite for the needed quantity of rather flavorless bread.

DIGESTIBILITY OF FRUIT.

In addition to the dietary studies, a large number of digestion experiments were made at the California Experiment Station for the purpose of learning how thoroughly a diet made up of various combinations of fruits and nuts was assimilated. In such an experiment covering 10 days, made with a child 7 years old, on an average 82 per cent. of the protein, 87 per cent. of the fat, 96 per cent. of the nitrogen-free extract (sugar, starches, etc.), 80 per cent. of the crude fiber, and 54 per cent. of the ash of the food eaten were digested, and 87 per cent. of the energy of the diet was available to the body. In 30 experiments with men, 75 per cent. of the protein, 86 per cent. of the fat, 95 per cent. of the nitrogen-free extract, 79 per cent. of the crude fiber, and 55 per cent. of the ash of the fruit and nut diet were digested, and 86 per cent. of the energy was available. These values are comparable with those obtained from an ordinary mixed diet, as is shown by the fact that in 93 experiments with young men 93 per cent. of the protein, 95 per cent. of the fat, and 98 per cent. of the total carbohydrates supplied were assimilated. The average coefficients of digestibility which have been calculated for fruits in connection with the nutrition investigations carried on under the auspices of the Office of Experiment Stations are protein 85 per cent., fat, 90 per cent., and carbohydrates 90 per cent., and those for fresh vegetables, protein 83 per cent., fat 90 per cent., and carbohydrates 95 per cent.

The feces excreted per person per day on the fruit and nut diet in the California experiments were less in amount than has been the case in some experiments with a mixed diet or a ration of bread and milk. This is contrary to what has been commonly found with a vegetarian diet made up of bread and other cereal foods, garden vegetables, etc., and containing little if any fruit or nuts. The percentage of so-called metabolic nitrogen in the feces from the fruit and nut diet did not exceed that reported by other investigators in tests with a bread and milk diet. In other words, if the amount of metabolic products can be looked upon as a measure of the work of digestion, no more effort is required to digest the fruit and nuts than is needed for bread and milk. Although, as Professor Jaffa points out, it is undoubtedly advisable to wait until more data have been obtained before making definite statements regarding the digestibility of fruits and nuts, enough has been done to show that they are almost completely digested and have a higher nutritive value than is popularly attributed to them. In view of this it is certainly an error to regard fruit as something of value only for its pleasant flavor or for its hygienic or medicinal properties, or to consider nuts simply as an accessory to an already hearty meal. As shown by the composition and digestibility of both fruit and nuts, they can be favorably compared with other and more common food.

So far as can be learned, comparatively few investigations have been made to ascertain the digestibility of particular fruits, raw or cooked. In a series of investigations by Bryant and Milner the digestibility of apple sauce was determined when eaten with a simple basal ration. The coefficients of digestibility for apple sauce alone were calculated in the usual way and were, protein, 28 per cent., nitrogen-free extract 99.6 per cent., crude fiber 96 per cent., and ash 100 per cent., while all the energy supplied by the apple sauce was considered to be available to the body. The coefficient of digestibility of protein is low, but, as the authors pointed out, the total amount of this constituent present was so small that it may be disregarded. This investigation, like those at the California Experiment Station, indicates that the fruit carbohydrates (sugar, starches, etc.), that is, the principal nutritive materials which fruits supply, are very thoroughly assimilated.

Few studies seem to have been made to determine the ease or rapidity of digestion of dicerent fruits in the stomach, but a comparison of available data indicates that fruits compare favorably with other common foods as regards stomach digestion. Apparently, it is fair to say that stomach digestion is influenced by the nature of the fruit and its stage of ripeness. Beaumont states that mellow sour apples eaten uncooked require 2 hours for digestion in the stomach and mellow sweet apples 1.5 hours. Another observer notes that about 5 ounces of raw ripe apple requires 3 hours and 10 minutes for digestion in the stomach, but states that if the fruit is unripe, and consequently contains a high proportion of cellulose, a much longer time may be required.

Little is definitely known regarding the relative digestion and absorption of fruits in the intestine, but experiments indicate that, as a class, ripe fruits are quite thoroughly digested, and it is evident that, generally speaking, fruits, like other foods, usually remain in the intestinal tract long enough for the body to absorb the nutritive material present, and that therefore the rate of intestinal digestion would not be a matter of special importance.

RELATIVE ECONOMY OF FRUITS AND OTHER FOODS.

In connection with his studies of the comparative value of fruits, Professor Jaffa summarizes data regarding the cost of nutrients and energy supplied by fruits as compared with some other foods at certain values per pound. Some of his data follow.

COMPARATIVE COST OF TOTAL NUTRIENTS AND ENERGY IN FRUITS AND OTHER FOOD MATERIALS AT CERTAIN AVERAGE PRICES.

Kind of Food Material.	Price per Pound	Cost of 1 Pound Protein	Cost of 1,000 Calories Energy	Amounts for 10 cents. Ttl. Weight of Food Mater'ls	Protein.	Fat.	Carbohydrates.	Energy.
FRESH FRUITS.	Cts.	D'llrs	Cts.	Lbs.	Lbs.	Lbs.	Lbs.	Cal's.
Apples	1.5	5.00	7.3	6.67	0.02	0.02	0.72	1,467
Bananas	7.0	8.75	23.3	1.43	.01	.....	.21	429
Grapes	4.0	4.00	11.9	2.50	.03	.03	.36	837
Oranges	6.0	10.00	35.2	1.67	.01	.....	.14	284
Peaches	4.0	8.00	25.1	2.50	.01	.....	.19	398
Pears	3.0	6.00	11.5	3.33	.02	.01	.42	866
Plums	3.0	3.33	8.1	3.33	.03	.....	.64	1,232
Watermelons	1.5	7.50	25.0	6.67	.01	.....	.18	400
Blackberries	7.0	5.38	25.9	1.43	.02	.01	.16	386
Cranberries	5.0	12.50	23.3	2.00	.01	.01	.20	430
Currants	5.0	3.33	18.9	2.00	.03	.....	.26	530
Raspberries	7.0	7.00	27.4	1.43	.01	.....	.18	365
Strawberries	7.0	7.78	40.0	1.43	.01	.01	.10	250
DRIED FRUITS.								
Apples	12.0	7.50	8.9	.83	.01	.02	.55	1,121
Dates	10.0	5.26	6.9	1.00	.02	.03	.71	1,450
Figs	15.0	8.50	10.2	.67	.03	.....	.50	988
Prunes	10.0	5.56	8.4	1.00	.02	.....	.62	1,190
Raisins	10.0	4.35	6.9	1.00	.02	.03	.69	1,445
JAMS, PRESERVES, ETC.								
Apple preserves	16.0	91.43	13.8	.62	.....	.....	.39	727
Apple butter	5.0	10.00	5.6	2.00	.01	.....	.94	1,780
Currant and raspberry jam	16.0	26.66	12.8	.62	.....	.....	.42	781
Gooseberry jam	16.0	32.00	13.3	.62	.....	.....	.40	752
Orange marmalade.	16.0	26.66	10.2	.62	.....	.....	.52	983
Prune sauce	16.0	32.00	37.2	.62	.....	.....	.14	267
Strawb'ry pres'ves.	16.0	26.67	12.0	.62	.....	.....	.44	833
Apple jelly	16.0	53.33	12.2	.62	.....	.....	.48	812
Currant jelly	16.0	40.00	13.4	.62	.....	.....	.40	744
Guava jelly	16.0	53.33	10.5	.62	.....	.....	.51	952

COMPARATIVE COST OF TOTAL NUTRIENTS AND ENERGY IN FRUITS AND OTHER FOOD MATERIALS AT CERTAIN AVERAGE PRICES.

(CONTINUED.)

Kind of Food Material.	Price per Pound	Cost of 1 Pound Protein	Cost of 1,000 Calories Energy	Amounts for 10 cents. Ttl. Weight of Food Mater'ls	Protein.	Fat	Carbo-hydrates.	Energy.
Quince jelly	16.0	80.00	13.3	.62	.....	.....	.40	750
Apricots, canned ..	16.0	17.78	47.1	.62	.01	.....	.11	211
Pears, canned	16.0	53.33	45.5	.62	.....	.....	.11	220
Peaches, canned ...	16.0	20.00	53.2	.62	.....	.....	.09	188
Grape juice	20.0	83.33	128.2	.50	.....	.....	.04	78
OTHER FOODS FOR COMPARISON.								
Porterhouse steak .	25.0	1.31	22.5	.40	.07	.07	.....	444
Leg mutton, hind...	20.0	1.30	22.2	.50	.07	.07	.....	445
Whole milk	3.5	1.06	10.5	2.86	.09	.11	.14	925
Skim milk	2.0	.59	11.8	5.00	.17	.02	.26	850
Wheat flour, patent roller process, high grade & medium.	2.5	.22	1.5	4.00	.46	.04	3.00	6,600
White bread	5.0	.54	4.2	2.00	.18	.03	1.06	2,430
Rye bread	5.0	.56	4.3	2.00	.18	.01	1.06	2,360
Sugar	6.0	......	3.2	1.67	.....	.....	1.67	3,106
Candy	20.0	......	11.2	.50	.....	.....	.48	892
Beans, dried	5.0	.22	3.1	2.00	.45	.03	1.19	3,210
Celery	5.0	5.56	71.4	2.00	.02	.....	.05	140
Potatoes, 90c. bush.	1.5	.83	4.8	6.67	.12	.01	.98	2,068

From the data in the foregoing table it appears that fruits are comparatively expensive sources of protein as compared with flour or dried legumes, the fruit juices being the most expensive and the dried fruits the cheapest of the fruit products. Ten cents on an average will purchase fully as much energy when spent for fresh fruits and more when spent for dried fruits than for lean meats, but much less than when expended for wheat flour. From the data as a whole, it is apparent that fruits are reasonably cheap sources of energy in the diet and are well suited on grounds of economy for combination in reasonable quantity with cheap proteid foods to furnish a well-balanced ration.

COOKING AND ITS EFFECTS ON FRUIT: JELLY MAKING.

As is the case with all vegetable foods, the heat of cooking breaks down the carbohydrate walls of the cells which make up the fruit flesh, either because the moisture or other cell contents expands and ruptures the walls or because the cell walls itself softened or dissolved. Texture, appearance and flavor of fruit are materially modified by cooking, and if thorough it insures sterilization, as in the case of all other foods. The change in texture often has a practical advantage, since it implies the softening of the fruit flesh so that it is more palatable and may be more readily acted upon by the digestive juices. This is obviously of more importance with the fruits like the quince, which is so hard that it is unpalatable raw, than it is with soft fruits like strawberries. When fruits are cooked without the addition of water or other material, as is often the case in baking apples, there is a loss of weight, owing to the evaporation of water, and the juice as it runs out carries some carbohydrates and other soluble constituents with it, but under ordinary household conditions this does not imply waste, as the juice which cooks out from fruit is usually eaten as well as the pulp. Cooking in water extracts some of the nutritive material present. Thus, a German investigator found that after boiling, apples and pears contained 4 or 5 per cent and peaches about 7 per cent less carbohydrates than the uncooked fruit. In this case also such removal of nutritive material is of no practical importance.

The idea is quite generally held that cooking fruit changes its acid content, acid being sometimes increased and sometimes decreased by the cooking process. Kelhofer showed that when gooseberries were cooked with sugar, the acid content was not materially changed, these results being in accord with his conclusions reached in earlier studies with other fruits. The sweeter taste of the cooked product he believed to be simply due to the fact that sugar masks the flavor of the acid.

It is often noted that cooked fruits, such as plums, seem much sourer than the raw fruit, and it has been suggested that either the acid was increased or the sugar was decreased by the cooking process. This problem was studied by Sutherst, and in his opinion the increased acid flavor is due to the fact that cooked fruit (gooseberries, currants, plums, etc.) usually contains the skin, which is commonly rejected if the fruit is eaten raw. The skin is more acid than the pulp, as was shown by analyses of gooseberries, in which the skin was found to contain 2.7 per cent acid and the pulp 1.8 per cent. To determine whether acid is formed when fruit is cooked, Sutherst boiled a mixture of nearly ripe gooseberries in water for about 30 minutes and then measured the amount of acid by trituration with sodium hydroxid solution. The boiled portion was found to contain less acid than the raw, probably because some of the acid was volatile and passed off with the steam.

As regards the effect of cooking on the kind and amount of sugar present, uncooked gooseberries were found to contain 1.2 per cent cane sugar and 5.8 per cent invert sugar. After boiling, no cane sugar was found while the invert sugar amounted to 6.9 per cent. This indicates that all the sugar undergoes inversion during cooking, the acid present bringing about the inversion in the usual way.

When fruits or fruit juices are cooked with sugar, the material very commonly solidifies or jellies on cooling, and this well-known property is taken advantage of in jelly making. In the case of some fruits, like the apple, the jelly-yielding material must be extracted from the fruit by cooking with hot water, while in the case of other fruits—the currant, for instance—this extraction with hot water is not necessary, as the expressed juice will produce a jelly. Heating the extracted or expressed juice is commonly considered a necessary step in jelly making, but some fruit juices will, on standing, jelly without heat, and laboratory tests have shown that jelly may also be obtained without the addition of sugar. Cooking and the addition of sugar are, however, important features in the practical consideration of jelly making, as they have a decided effect upon the yield, flavor, and keeping qualities of the resulting product.

Some fruits, like the ordinary varieties of pear, possess so little of the jelly-yielding material or possess it in such an unusual form that they do not yield a good jelly under ordinary household methods of treatment. The proportion of jelly-yielding material, like other constituents, varies with the stage of maturity, underripe rather than overripe fruit being best for the purpose.

The jelly-yielding bodies are known to be carbohydrates and have been called pectin, pectose, pectin bodies or some similar name. They have been commonly grouped with the plant gums and similar carbohydrates, and the true nature of these materials has been the subject of a great deal of study. At the present time the consensus of opinion seems to be that the pectins are composed of several of the simpler carbohydrates united to form a complex carbohydrate. In some fruits, like the apple, where the jelly-yielding material must be extracted with hot water, the pectin is apparently united with cellulose as a part of the solid pulp. As shown by the investigations of Bigelow and Gore at the Bureau of Chemistry, 40 per cent of the solid material of apple pulp may be thus extracted with

hot water, and consists of two carbohydrates, one of which is closely related to gum arabic. That such carbohydrates as these should yield a jelly is not surprising when we remember that they are similar to starch in their chemical nature, and, as everyone knows, starch, though insoluble in cold water, yields when cooked with hot water a large proportion of paste which jellies on cooling.

When fruits are used for making pies, puddings, etc., the nutritive value of the dish is, of course, increased by the addition of flour, sugar, etc., and the dish as a whole may constitute a better balanced food than the fruit alone. It is commonly believed that dishes in which fruits are cooked with the addition of sugar, butter, and a flour crust of some sort are less easily digested than simple rations of bread, butter, and fruit having an equivalent nutritive value. The large number of digestion experiments which have been made with various mixed diets do not indicate that there is any special difference between the two rations as regards thoroughness of digestion, but additional experiments must be undertaken before it can be said with certainty whether or not there are actual differences in the ease and rapidity of digestion.

In different countries opinions vary markedly regarding the relative wholesomeness of raw and cooked fruit. Thus, as has often been pointed out, the Germans use comparatively little raw fruit and consider it far less wholesome than cooked fruit. On the other hand, in the United States raw fruit of good quality is considered extremely wholesome, and is used in very large quantities, being as much relished as cooked fruit, if indeed it is not preferred to it. It has been suggested that the European prejudice against raw fruit may be an unconscious protest against insanitary methods of marketing or handling and the recognition of cooking as a practical method of preventing the spread of disease by fruit accidently soiled with fertilizers in the fields or with street dust.

OVERRIPE, DECAYED, AND UNRIPE FRUIT.

Overripe fruit is often injurious, very probably because it has begun to ferment, and stale or partially decayed fruit is obviously undesirable for food purposes. In addition to a deterioration in flavor there is always the possibility of digestive disturbance if such fruit is eaten raw. Of course, where apples are raised or where they are bought in large quantities for family use the thrifty housewife will sort them over and use for cooking the sound portions of those which have begun to decay. In such cases, however, the best available methods of storing should be followed and sorting should be done at frequent intervals, for if decay has proceeded very far the flavor is without doubt injured.

If fruits could be kept unbruised and with the skin unbroken, decay would be much delayed, as the mold spores, rots, etc., which cause decay, find their readiest entrance through broken skins. That mechanical injuries are the principal causes of decay was shown in a study of citrus fruits. When the skin of an orange or lemon is broken the blue mold finds access to the wound, and under favorable conditions of moisture and temperature develops readily and causes decay. An examination of hundreds of boxes of California oranges showed that a large percentage of all the fruit was made susceptible to such decay by accidental injuries to the skin in packing.

It is not at all strange that decayed fruit should have a decided characteristic odor and flavor when we remember that the decay is very commonly caused by fungi, especially molds and rots, which penetrate the pulp and grow and develop rapidly. The fungi live upon the cell contents, particularly sugars and proteids, and produce bodies of marked chemical characteristics, including odor and flavor. It is said that the most unpleasant effects are due to one of the common molds.

It is almost universally believed that green fruit is unwholesome and causes serious digestive disturbances, yet those who have been brought up in the country know that if illness had always followed eating it there would have been few well children in the community in the summer. Recognizing that green fruit may be a cause of illness at times and at other times apparently harmless, two German scientists have recently carried on extensive studies to ascertain the truth of the matter. Chemical analyses were made of fruits of varying degress of ripeness, and studies in which green fruit was eaten in considerable quantities and under varying conditions were carried on with both animals and men. It appears from the results of the experiments that although unripe fruit is undoubtedly often harmful, particularly for children, the danger from such foods, especially green gooseberries, plums, pears and apples, when eaten raw, is less than is commonly thought, and the effects depend in marked degree upon individual peculiarities.

The green fruit was found to contain the same chemical compounds as the ripe fruit, though in different proportions—that is, no chemical element was found in the green fruit which was foreign to the ripe fruit, and which could be considered in itself a cause of illness. The injurious effects of raw unripe fruit, therefore, it appears, do not depend upon chemical constituents, but rather on the unusual proportions in which the constituents occur, and especially the large percentage of hard cell tissue, which, if imperfectly masticated, it will readily be seen, might be a source of digestive derangement. Possibly the excess of acid in the green fruit is also a cause of digestive disturbance. Cooked green fruit was found to be practically harmless, being especially palatable and wholesome when cooked with sugar.

The possibility of injury by bacterial contamination was considered, though the data available were not sufficient for final deductions. It is now well known that such diseases are usually caused by micro-organisms; so possibly the green fruit, very frequently picked up beneath the tree, is only an accidental carrier of the real cause of the digestive disturbances which may follow eating it.

HANDLING AND MARKETING FRUIT.

It is very important that fruits should be handled, stored and marketed under sanitary conditions, as they are very commonly eaten raw, and not all persons are careful to wash them before serving. Fruit which has fallen to the ground may be readily soiled with earth, water, or other material which may contain typhoid or other bacteria. Indeed, cases of infection have been traced to fruits contaminated in this or some similar way and which were eaten raw without being washed. Investigations have also shown that fruits exposed to street dust and to other unfavorable conditions become covered with bacteria, which are always present in such dust-laden air, and may be possible sources of contagion. Flies and other insects are also known to be a source of dirt and contamination. Samples of fruit purchased in the street and examined by a German investigator (Ehrlich) showed tuberculosis bacteria and many other forms of micro-organisms, the number present varying considerbly with different sorts of fruit.

Realizing that fruit exposed to street dust and insects may be a means of spreading disease, measures have

been taken in Vienna to prevent such conditions, and fruit offered for sale must be covered with gauze or otherwise protected. In connection with the Vienna investigations microscopic examinations were made of the skins of plums and pears purchased at a much-patronized fruit shop. It was found that the main source of contamination was dust containing fragments of stone from the street pavement and bits of horse manure.

As might be expected, Ehrlich found that those fruits with a firm dry skin, such as apples, did not furnish as good a lodging place for bacteria and dust as fruits with a sticky surface, such as berries. Sticky dried fruits, such as dates, raisins, and figs, are also, as will be readily seen, favorable resting places for dirt and dust, as almost anything which the moving air currents lodge on the sticky surface will remain there. Fortunately, it is becoming a common practice to market such fruits in closed packages, usually of cardboard, which protect them to a great extent from dust and insects, so that the dried fruit, if clean in the first place, will remain clean.

It is often urged that washing fruit destroys flavor. On the other hand, skillful housewives maintain that if properly done the loss of flavor is inappreciable, and on the grounds of common cleanliness it would seem best to sacrifice a little flavor, if necessary, for the sake of removing filth and possibly dangerous bodies, even if the amount of dirt present is too small to be offensive to sight or taste.

Ehrlich, whose work has been cited, found that washing fresh fruit once thoroughly in running water was sufficient to remove the micro-organisms present. If the fruit had been kept until the sticky surface was more or less dry, washing two or three times was found desirable. With apples and pears he recommends wiping with a clean dry cloth, followed by rinsing under the water tap. As is well known, berries, and other soft fruits sour and mold very readily if damp; they should therefore be washed just before they are served.

When fruit is washed the amount of material removed is small. In the case of soft fruits, like berries, with a surface skin which is very thin and easily broken, it is almost certain that larger quantities will be removed than with firm fruit.

An idea of the amount of material removed by washing fresh fruits, such as the apple, which is protected by a firm skin, may be gathered from some French experiments made to study the effects of washing apples used in cider making. Each apple in a 45-pound lot was washed separately in distilled water. The wash water took on a dirty black color and also had a disagreeable odor, and analyses showed that per 1,000 pounds of apples it contained about 0.3 pound total dry matter, the greater part of the dry matter being made up of sugar, with smaller amounts of pectin bodies, malic acid, and ash. The juice of washed and unwashed fruit was practically identical in composition It is evident that the loss represented is too small to be of any practical account from the standpoint of economy, but even less than 0.3 pound of dirt per 1,000 pounds of fruit is something which all would wish to avoid when attention has once been directed to it.

On the whole, it seems fair to conclude that, notwithstanding the prejudice which many housewives have against the practice of washing fruit, it is unquestionably safest never to omit the precaution of washing fruit which is to be eaten raw, unless one can be quite certain that it has not been exposed to possible contamination.

Metchnikoff insists that there is danger of acquiring harmful intestinal parasites or their eggs from raw fruits and vegetables, particularly those liable to come in contact with the soil, and he believes that in all such doubtful cases these foods should be cooked, or at least scalded in hot water, before they are eaten.

Much of the dust and dirt and other unpleasant features might be avoided if our methods of handling and marketing fruit and other food products were at all comparable with our standards of sanitation in other lines and with what is easily possible. Improvements in present market conditions, however, can hardly be expected until the public demands them.

STORING FRUIT.

The manner in which fruits are transported and stored has a market effect on quality. Low temperature retards after-ripening and decay and is the agent most depended upon at the present time, and refrigerator cars and cold-storage warehouses are now very common adjuncts of the fruit industry. It is said that a temperature of 31 to 32° F. is best for storing apples, pears, peaches and oranges. Another authority gives 32° F. for cantaloupes and watermelons, 33 to 34° F. for cranberries, 34 to 36° F. for berries and bananas, 36° F. for lemons, and 35 to 40° F. for dried fruits. Tender fruits, it is said, will keep best if they are stored just when they are fully ripe, and sweet fruits will stand a lower temperature than sour fruits. The length of time fruits may be kept in cold storage varies with the kind, the degree of ripeness, the method of handling, and other conditions. With berries, it is a question of days; with peaches, melons and other soft fruits, of weeks; and with apples and pears, of months.

Though pears of suitable varieties are frequently kept for winter use, apples are the fruit most commonly stored in the household, at least in the central and northern regions of the United States. For success a uniform temperature is essential, the nearer 32° F. the better. The air of the cellar or the storeroom must be moderately dry; that is, it must be moist enough to prevent fruit from shriveling and dry enough to be unfavorable to mold growth. The room must also be sweet and clean, as fruits will readily absorb unpleasant odors. Apples kept too near the turnip bin are very apt to hav an unpleasant taste. It is also best to avoid drafts, especially when storing pears. Barrels and bins each have their advocates, but the consensus of opinion seems to be that both are satisfactory and the choice of one or the other simply a matter of convenience. If it is desired to keep apples or pears an unusually long time, the individual fruits should be wrapped in clean unprinted paper which is not too thick.

THE HYGIENE OF FRUIT.

Generally speaking, fruits are wholesome and palatable foods, yet it is not at all uncommon to find that one or more sorts cannot be eaten by an individual. Thus many persons find that strawberries cause distress and many others that any acid fruit is a cause of digestive disturbance. Such cases are explained on the ground of some personal idiosyncrasy.

The extended use of fruit in the diet is certainly justified on the ground of palatibility, food value and esthetic considerations, but there are those who seek a further justification on the score of hygiene. It is commonly conceded that most fruits are laxative, and it seems probable that they owe this property to the considerable amount of water which they contain, to the salts in solution, or to the irritating crude fiber, small seeds, or other indigestible materials present, or to all these together. Man seems to crave and require

some acid in his diet, and the citric, malic and other fruit acids are undoubtedly wholesome.

The importance of fresh fruits and green vegetables in supplying the body with iron and other mineral matters is often spoken of, and it is true that the amount of iron, for instance, which many such foods contain is large in proportion to their protein content or their energy value. This means that if the ordinary diet does not supply enough of some mineral constituent it may be obtained by adding the fruit or green vegetable, which will give it without materially adding to the nutrients and energy of a diet already abundant in these respects.

Considerable bulk is an essential factor in the diet. If the foods eaten were of such a nature as to be almost completely absorbed, the large intestine would not readily empty itself and serious complications would follow. For this reason, bulky foods, like fresh, succulent vegetables and fruit, are of importance, as they usually contain a considerable proportion of indigestible matter.

In earlier times remarkable virtues or the opposite were commonly attributed to fruits, plants, precious stones, and other animate and inanimate objects, and it seems not improbable that the medicinal virtues which are often ascribed to various fruits in popular writings are survivals of this custom. No well-informed person would today share the belief, once so widespread, that tomatoes are the cause of cancer, yet many apparently give credence to statements that certain fruits are a satisfactory food for brain workers, while others must be avoided. At any rate, such statements are often found in print. In general, it may be said that very few investigations have been made which indicate that the different fruits possess specific medicinal qualities. Those which contain an abundance of sugar are naturally excluded in large measure from the diet of diabetics, while there are other conditions in which acid fruits are conceded to be undesirable.

To the juice of acid fruits like the lime, lemon, orange, pomelo or "grape fruit," and the kumquat (the small orange which is eaten entire, both skin and pulp) hygienic properties are commonly attributed, and there is reason to believe that this reputation is deserved. Such fruit juices stimulate the appetite and are beneficial in other ways. The bitter principle in the pomelo is commonly said to be of value medicinally, perhaps because it suggests the bitter flavor of quinine, but so far as can be learned, the real value of this bitter quality is a matter of opinion rather than of experimental study.

Some fruits, notably the tropical papaw and the pineapple, contain very active ferments. The ferment present in the papaw is separated in commercial quantities and used as a digester of nitrogenous materials. Perhaps it is quite natural that much stress should have been laid on the ferment present in the pineapple and that this fruit should be recommended for use at the end of a meal, so that its ferment may aid the body in digesting food. It should be remembered, however, that the body in health does not need artificial aid in performing its normal functions, and that for digestive disturbances it would be wiser to seek competent medical advice than to depend on the casual use of pineapple or other plant ferment, especially when it is remembered that there is great doubt as to the efficacy of any ferments introduced artificially into the stomach.

Fortunately there are so many other good reasons for using fruits that we have little need to base our use of them in quantity on supposed medicinal virtues.

As shown by statistics based on the results of dietary studies of nearly 400 American families, fresh fruits make up 3.8 per cent. of the total food and supply 2.5 per cent of the total carbohydrates. Similarly dried fruits furnish 0.6 per cent. of the total food and 1.2 per cent of the total carbohydrates. The values for fruits as a whole, therefore, are 4.4 per cent of the total food material and 3.7 per cent. of the total carbohydrates. These figures are not large in themselves, yet compare favorably with the values for different groups of vegetable foods. Thus the same compilation shows that vegetables, other than legumes, potatoes and sweet potatoes, furnish 6.2 per cent. of the total food and 1.7 per cent. of the total carbohydrates of the average American diet.

Besides the fruit consumed at home a great amount is exported, and there is no doubt that fruit growing is one of the important agricultural industries of the United States, and one which is rapidly developing.

CONCLUSIONS.

In general, it may be said that fruits are wholesome, palatable and attractive additions to our diet, and may be readily made to furnish a considerable part of the nutrients and energy required in the daily fare. Fresh fruits are dilute foods and closely resemble green vegetables in total nutritive value, but dried fruits and many preserves, etc., are much more concentrated, comparing favorably with some of the cereals and other dry vegetable foods in the amount of total nutrients and energy which they supply per pound. The characteristic chemical constituents of fruits are carbohydrates, and so they are naturally and properly used in a well-balanced diet to supplement foods richer in protein, as cereal grains, legumes, nuts, eggs, dairy products, meats and fish. Fruits contain considerable mineral matter, and as they are dilute foods they may be added to the diet to supply iron and other mineral constituents without unduly increasing the supply of protein and energy. Since they are bulky and often contain fairly large proportions of indigestible material, fruits stimulate what might otherwise be a sluggish intestine. Intelligently used, fruits are a valuable part of a well-balanced diet and may well be eaten in larger quantities than at present.

CANNING AND PRESERVING FRUIT

INTRODUCTION.

The common fruits, because of their low nutritive value, are not, as a rule, estimated at their real worth as food. Fruit has great dietetic value and should be used generously and wisely, both fresh and cooked. Fruits supply a variety of flavors, sugar, acids and a necessary waste or bulky material for aiding in intestinal movement. They are generally rich in potash and soda salts and other minerals. Most fresh fruits are cooling and refreshing. The vegetable acids have a solvent power on the nutrients and are an aid to digestion when not taken in excess.

Fruit and fruit juices keep the blood in a healthy condition when the supply of fresh meat, fish and vegetables is limited and salt or smoked meats constitute the chief elements of diet. Fresh fruit is generally more appetizing and refreshing than cooked. For this reason it is often eaten in too large quantities, and frequently when underripe or overripe; but when of good quality and eaten in moderate quantities it promotes healthy intestinal action and rarely hurts anyone.

If eaten immoderately, uncooked fruit is apt to induce intestinal disturbances. If eaten unripe, it often causes stomach and intestinal irritation; overripe, it has a tendency to ferment in the alimentary canal. Cooking changes the character and flavor of fruit, and while the product is not so cooling and refreshing as in the raw state, it can, as a rule, be eaten with less danger of causing stomach or intestinal trouble. If sugar be added to the cooked fruit, the nutritive value will be increased. A large quantity of sugar spoils the flavor of the fruit and is likely to make it less easily digested.

Nowhere is there greater need of a generous supply of fruit than on the farm, where the diet is apt to be restricted in variety because of the distance from markets. Every farmer should raise a generous supply of the kinds of fruit that can be grown in his locality. Wives and daughters on the farms should find pleasure in serving these fruits in the most healthful and tempting form. There are a large number of simple, dainty desserts that can be prepared with fruit and without much labor. Such desserts should leave the pie as an occasional luxury instead of allowing it to be considered a daily necessity.

In the season when each kind of fruit is plentiful and at its best a generous supply should be canned for the season when both fruit and fresh vegetables are scarce. A great deal of the fruit should be canned with little or no sugar, that it may be as nearly as possible in the condition of fresh fruit. This is the best condition for cooking purposes. A supply of glass jars does cost something, but that item of expense should be charged to future years, as with proper care the breaking of a jar need be a rare occurrence. If there be an abundance of grapes and small, juicy fruits, plenty of juice should be canned or bottled for refreshing drinks throughout the year. Remember that the fruit and juice are not luxuries, but an addition to the dietary that will mean better health for the members of the family and greater economy in the cost of the table.

FRESH AND PRESERVED FRUIT FOR THE MARKET.

If the supply of fruit is greater than the family needs, it may be made a source of income by sending the fresh fruit to the market, if there is one near enough, or by preserving, canning and making jelly for sale. To make such an enterprise a success the fruit and work must be first class. There is magic in the word "Homemade," when the product appeals to the eye and the palate; but many careless and incompetent people have found to their sorrow that this word has not magic enough to float inferior goods on the market. As a rule large canning and preserving establishments are clean and have the best appliances, and they employ chemists and skilled labor. The home product must be very good to compete with the attractive goods that are sent out from such establishments. Yet for first-class homemade products there is a market in all large cities. All first-class grocers have customers who purchase such goods.

To secure a market get the names of several first-class grocers in some of the large towns. Write to them asking if they would be willing to try a sample of your goods. If the answer is favorable, send samples of the articles you wish to sell. In the box with the fruit inclose a list of the articles sent and the price. Write your name and address clearly. Mail a note and a duplicate list at the time you send the box.

Fixing the price of the goods is important. Make it high enough to cover all expenses and give you a fair return for your labor. The expenses will be the fruit, sugar, fuel, jars, glasses, boxes, packing material, wear and tear of utensils, etc., transportation and commission. The commission will probably be 20 per cent. of the selling price. It may be that a merchant will find that your prices are too high or too low for his trade, or he may wish to purchase the goods outright. In any case it is essential that you estimate the full cost of the product and the value that you place on your labor. You will then be in a position to decide if the prices offered will compensate you for the labor and expense. Do not be tempted, for the sake of a little money, to deprive your family of the fruit necessary to health and pleasure.

PACKING AND SHIPPING.

Each jar or jelly glass must be wrapped in several thicknesses of soft paper (newspapers will answer). Make pads of excelsior or hay by spreading a thick layer between the folds of newspapers. Line the bottom and sides of the box with these pads. Pack the fruit in the padded box. Fill all the spaces between the jars with the packing material. If the box is deep and a second layer of fruit is to go in, put thick pasteboard on thin boards over the first layer and set wrapped jars on this. Fill all the spaces and cover the top with the packing material. Nail on the cover and mark clearly: GLASS. THIS SIDE UP.

The great secret in packing is to fill every particle of space so that nothing can move.

PRINCIPLES OF CANNING AND PRESERVING.

In the preservation of foods by canning, preserving, etc., the most essential things in the processe sare the

sterilization of the food and all the utensils and the sealing of the sterilized food to exclude all germs.

BACTERIA, YEASTS, AND FERMENTATION.

Over one hundred years ago Francois Appert was the first to make practical application of the method of preserving food by putting it in cans or bottles, which he hermetically sealed. He then put the full bottles or cans in water and boiled them for more or less time, depending upon the kinds of food.

In Appert's time and, indeed, until recent years, it was generally thought that the oxygen of the air caused the decomposition of food. Appert's theory was that the things essential to the preservation of food in this manner were the exclusion of air and the application of gentle heat, as in the water bath, which caused a fusion of the principal constituents and ferments in such a manner that the power of the ferments was destroyed.

The investigations of scientists, particularly of Pasteur, have shown that it is not the oxygen of the air which causes fermentation and putrefaction, but bacteria and other microscopic organisms.

Appert's theory as to the cause of the spoiling of food was incorrect, but his method of preserving it by sealing and cooking was correct, and the world owes him a debt of gratitude.

In their investigations scientists have found that if food is perfectly sterilized and the opening of the jar or bottle plugged with sterilized cotton, food will not ferment, for the bacteria and yeasts to which such changes are due cannot pass through the cotton. This method cannot be conveniently followed with large jars.

Bacteria and yeasts exist in the air, in the soil, and on all vegetable and animal substances, and even in the living body, but although of such universal occurrence, the true knowledge of their nature and economic importance has only been gained during the last forty years.

There are a great many kinds of these micro-organisms. Some do great harm, but it is thought that the greater part of them are beneficial rather than injurious.

Bacteria are one-celled and so small they can only be seen by aid of a microscope. The process of reproduction is simple and rapid. The bacterium becomes constricted, divides, and finally there are two cells instead of one. Under favorable conditions each cell divides, and so rapid is the work that it has been estimated that one bacterium may give rise, within twenty-four hours, to seventeen millions of similar organisms. The favorable conditions for growth are moisture, warmth and proper food.

Yeasts, which are also one-celled organisms, grow less rapidly. A bud develops, breaks off, and forms a new yeast plant. Some yeasts and some kinds of bacteria produce spores. Spores, like the dried seeds of plants, may retain their vitality for a long time, even when exposed to conditions which kill the parent organism.

Yeasts and nearly all bacteria require oxygen, but there are species of the latter that seem to grow equally well without it, so that the exclusion of air, which, of course, contains oxygen, is not always a protection, if one of the anaerobic bacteria, as the kinds are called which do not require oxygen, is sealed in the can.

Spoiling of food is caused by the development of bacteria or yeasts. Certain chemical changes are produced as shown by gases, odors and flavors.

Bacteria grows luxuriantly in foods containing a good deal of nitrogenous material, if warmth and moisture are present. Among foods rich in nitrogenous substances are all kinds of meat, fish, eggs, peas, beans, lentils, milk, etc. These foods are difficult to preserve on account of the omnipresent bacteria. This is seen in warm, muggy weather, when fresh meat, fish, soups, milk, etc., spoil quickly. Bacteria do not develop in substances containing a large percentage of sugar, but they grow rapidly in a suitable wet substance which contains a small percentage of sugar. Yeasts grow very readily in dilute solutions containing sugars in addition to some nitrogenous and mineral matters. Fruits are usually slightly acid and in general do not support bacterial growth, and so it comes about that canned fruits are more commonly fermented by yeast than by bacteria.

Some vegetable foods have so much acid and so little nitrogenous substance that very few bacteria or yeasts attack them. Lemons, cranberries and rhubarb belong to this class.

Temperature is an important factor in the growth of bacteria and yeasts. There are many kinds of these organisms, and each kind grows best at a certain temperature, some at a very low one and others at one as high as 125° F., or more. However, most kinds of bacteria are destroyed if exposed for ten or fifteen minutes to the temperature of boiling water (212° F.); but, if the bacteria are spore producers, cooking must be continued for an hour or more to insure their complete destruction. Generally speaking, in order to kill the spores the temperature must be higher than that of boiling water, or the article to be preserved must be cooked for about two hours at a temperature of 212° F., or a shorter time at a higher temperature under pressure. Yeasts and their spores are, however, more easily destroyed by heat than bacteria spores. Hence, fruits containing little nitrogenous material are more easily protected from fermentation than nitrogenous foods in which in general fermentation is caused by bacteria. Of course, it is not possible to know what kinds of organisms are in the food one is about to can or bottle; but we do know that most fruits are not favorable to the growth of bacteria, and, as a rule, the yeasts which grow in fruits and fruit juice can be destroyed by cooking ten or fifteen minutes at a temperature of 212° F. If no living organisms are left, and the sterilization of all appliances has been thorough, there is no reason why the fruit, if properly sealed, should not keep, with but slight change of texture or flavor, for a year or longer, although canned fruits undergo gradual change and deterioration even under the most favorable conditions.

When fruit is preserved with a large amount of sugar (a pound of sugar to a pound of fruit) it does not need to be hermetically sealed to protect it from bacteria and yeasts, because the thick, sugary sirup formed is not favorable to their growth. However, the self-sealing jars are much better than keeping such fruit in large receptacles, from which it is taken as needed, because molds grow freely on moist, sugary substances exposed to the air

MOLDS AND MOLDING.

Every housekeeper is familiar with molds which, under favorable conditions of warmth and moisture, grow upon almost any kind of organic material. This is seen in damp, warm weather, when molds form in a short time on all sorts of starchy foods, such as boiled potatoes, bread, mush, etc., as well as fresh, canned, and preserved fruits.

Molds develop from spores which are always floating about in the air. When a spore falls upon a substance containing moisture and suitable food it sends out a fine thread, which branches and works its way over and into the attacked substance. In a short time spores are produced and the work of reproduction goes on.

In the first stages molds are white or light gray and hardly noticeable; but when spores develop the growth gradually becomes colored. In fact, the conditions of advanced growth might be likened to those of a flower garden. The threads—mycelium—might be likened to the roots of plants and the spores to the flower and seeds.

Mold spores are very light and are blown about by the wind. They are a little heavier than air, and drop on shelves, tables, and floor, and are easily set in motion again by the movement of a brush, duster, etc. If one of these spores drops on a jar of preserves or a tumbler of jelly, it will germinate if there be warmth and moisture enough in the storeroom. Molds do not ordinarily cause fermentation of canned foods, although they are the common cause of the decay of raw fruits. They are not as injurious to canned goods as are bacteria and yeasts. They do not penetrate deeply into preserves or jellies, or into liquids or semiliquids, but if given time they will, at ordinary room temperature, work all through suitable solid substances which contain moisture. Nearly every housekeeper has seen this in the molding of a loaf of bread or cake.

In the work of canning, preserving and jelly making it is important that the food shall be protected from the growth of molds as well as the growth of yeasts and bacteria.

To kill mold spores food must be exposed to a temperature of from 150° F. to 212° F. After this it should be kept in a cool, dry place and covered carefully that no floating spore can find lodgment on its surface.

STERILIZATION.

To sterilize a substance or thing is to destroy all life and sources of life in and about it. In following the brief outline of the structure and work of bacteria, yeasts and molds, it has been seen that damage to foods comes through the growth of these organisms on or in the food; also that if such organisms are exposed to a temperature of 212° F., life will be destroyed, but that spores and a few resisting bacteria are not destroyed at a temperature of 212° F., unless exposed to it for two or more hours.

Bacteria and yeasts, which are intimately mixed with food, are not as easily destroyed as are those on smooth surfaces, such as the utensils and jars employed in the preparation of the food.

Since air and water, as well as the foods, contain bacteria and yeasts, and may contain mold spores, all utensils used in the process of preserving foods are liable to be contaminated with these organisms. For this reason all appliances, as well as the food, must be sterilized.

Stewpans, spoons, strainers, etc., may be put on the fire in cold or boiling water and boiled ten or fifteen minutes. Tumblers, bottles, glass jars and covers should bt put in cold water and heated gradually to the boiling point, and then boiled for ten or fifteen minutes. The jars must be taken one at a time from the boiling water be put in cold water and heated gradually to the boiling food. The work should be done in a well swept and dusted room, and the clothing of the workers and the towels used should be clean. The food to be sterilized should be perfectly sound and clean.

As in this bulletin we have only to do with fruits, it will not be necessary to say anything more about long cooking at a high temperature.

In canning fruits it is well to remember that the product is more satisfactory if heated gradually to the boiling point and then cooked the given time.

UTENSILS NEEDED FOR CANNING AND PRESERVING.

In preserving, canning and jelly making iron or tin utensils should never be used. The fruit acids attack these metals and so give a bad color and metallic taste to the products. The preserving kettles should be porcelain lined, enameled, or of a metal that will not form troublesome chemical combinations with fruit juices. The kettles should be broad rather than deep, as the fruit should not be cooked in deep layers. Nearly all the necessary utensils may be found in some ware not subject to chemical action. A list of the most essential articles follows:

Two preserving kettles, one colander, one fine strainer, one skimmer, one ladle, one large-mouthed funnel, one wire frying basket, one wire sieve, four long-handled wooden spoons, one wooden masher, a few large pans, knives for paring fruit (plated if possible), flat-bottomed clothes boiler, wooden or willow rack to put in the bottom of the boiler, iron tripod or ring, squares of cheese cloth. In addition, it would be well to have a flannel straining bag, a frame on which to hang the bag, a syrup gauge and a glass cylinder, a fruit pricker, and plenty of clean towels.

The regular kitchen pans will answer for holding and washing the fruit. Mixing bowls and stone crocks can be used for holding the fruit juice and pared fruit. When fruit is to be plunged into boiling water for a few minutes before paring, the ordinary stewpans may be employed for this purpose.

Scales are a desirable article in every kitchen, as weighing is much more accurate than the ordinary measuring. But, knowing that a large percentage of the housekeepers do not possess scales, it has seemed wise to give all the rules in measure rather than weight.

If canning is done by the oven process, a large sheet of asbestos, for the bottom of the oven, will prevent the cracking of jars.

The wooden rack, on which the bottles rest in the washboiler, is made in this manner: Have two strips of wood measuring 1 inch high, 1 inch wide, and 2 inches shorter than the length of the boiler. On these pieces of wood tack thin strips of wood that are 1½ inches shorter than the width of the boiler. These cross-strips should be about 1 inch wide, and there should be an inch between two strips. This rack will support the jars and will admit the free circulation of boiling water about them. Young willow branches, woven into a mat, also make a good bed for bottles and jars.

The wire basket is a saver of time and strength. The fruit to be peeled is put into the basket, which is lowered into a deep kettle partially filled with boiling water. After a few minutes the basket is lifted from the boiling water, plunged for a moment into cold water, and the fruit is ready to have the skin drawn off.

A strong wire sieve is a necessity when purees of fruit are to be made. These sieves are known as puree sieves. They are made of strong wire and in addition have supports of still stronger wire.

A fruit pricker is easily made and saves time. Cut a piece half an inch deep from a broad cork; press through this a dozen or more coarse darning needles; tack the cork on a piece of board. Strike the fruit on the bed of needles, and you have a dozen holes at once. When the work is finished, remove the cork from the board, wash and dry thoroughly. A little oil on the needles will prevent rusting. With needles of the size suggested there is little danger of the points breaking, but it is worth remembering that the use of prinking machines was abandoned in curing prunes on a com-

mercial scale in California because the steel needles broke and remained in the fruit.

A wooden vegetable masher is indispensable when making jellies and purees.

A syrup gauge and glass cylinder are not essential to preserving, canning and jelly making, but they are valuable aids in getting the right proportion of sugar for fruit or jelly. The syrup gauge costs about 50 cents and the cylinder about 25 cents. A lipped cylinder that holds a little over a gill is the best size.

Small iron rings, such as sometimes come off the hub of cart wheels, may be used instead of of a tripod for slightly raising the preserving kettles from the hot stove or range.

To make a flannel straining bag, take a square piece of flannel (27 by 27 inches is a good size), fold it to make a three-cornered bag, stitch one of the sides, cut the top square across, bind the opening with strong, broad tape, stitch on this binding four tapes with which to tie the bag to a frame.

To use this bag, tie it to a strong frame or to the backs of two kitchen chairs. If the chairs are used, place some heavy articles in them; or the bag may hang on a pole (a broom handle) which rests on the backs of the chairs. A high stool turned upside down makes a good support for the bag. Put a bowl on the floor under the bag, then pour in the fruit juice, which will pass through comparatively clear.

Before it is used the bag should be washed and boiled in clear water.

SELECTION AND PREPARATION OF THE FRUIT.

The selection of fruit is one of the first steps in obtaining successful results. The flavor of fruit is not developed until it is fully ripe, but the time at which the fruit is at its best for canning, jelly making, etc., is just before it is perfectly ripe. In all soft fruits the fermentative stage follows closely upon the perfectly ripe stage, therefore it is better to use underripe rather than overripe fruit. This is especially important in jelly making for another reason also: In overripe fruit the pectin begins to lose its jelly-making quality.

All fruits should, if possible, be freshly picked for preserving, canning and jelly making. No imperfect fruit should be canned or preserved. Gnarly fruit may be used for jellies or marmalades by cutting out defective portions. Bruised spots should be cut out of peaches and pears. In selecting small-seeded fruits, like berries, for canning, those having a small proportion of seed to pulp should be chosen. In dry seasons berries have a larger proportion of seeds to pulp than in a wet or normal season, and it is not wise to can or preserve such fruit unless the seeds are removed. The fruit should be rubbed through a sieve that is fine enough to keep back the seeds. The strained pulp can be preserved as a puree or marmalade.

When fruit is brought into the house put it where it will keep cool and crisp until you are ready to use it.

The preparation of fruit for the various processes of preserving is the second important step. System will do much to lighten the work.

Begin by having the kitchen swept and dusted thoroughly, that there need not be a large number of mold spores floating about. Dust with a damp cloth. Have plenty of hot water and pans in which jars and utensils may be sterilized. Have at hand all necessary utensils, towels, sugar, etc.

Prepare only as much fruit as can be cooked while it still retains its color and crispness. Before beginning to pare fruit have some syrup ready, if that is to be used, or if sugar is to be added to the fruit have it weighed or measured.

Decide upon the amount of fruit you will cook at one time, then have two bowls—one for the sugar and one for the fruit—that will hold just the quantity of each. As the fruit is pared or hulled, as the case may be, drop it into its measuring bowl. When the measure is full put the fruit and sugar in the preserving kettle. While this is cooking another measure may be prepared and put in the second preserving kettle. In this way the fruit is cooked quickly and put in the jars and sealed at once, leaving the pans ready to sterilize another set of jars.

If the fruit is to be preserved or canned with syrup, it may be put into the jars as fast as it is prepared. As soon as a jar is full, pour in enough syrup to cover it.

If several people are helping and large kettles are being used for the preserving, or where fruit (like quinces and hard pears) must be first boiled in clear water, the pared fruit should be dropped into a bowl of cold water, made slightly acid with lemon juice (one tablespoonful of lemon juice to a quart of water). This will keep the fruit white.

All large, hard fruit must be washed before paring. Quinces should be rubbed with a coarse towel before they are washed.

If berries must be washed, do the work before stemming or hulling them. The best way to wash berries is to put a small quantity into a colander and pour cold water over them; then turn them on a sieve to drain. All this work must be done quickly that the fruit may not absorb much water.

Do not use the fingers for hulling strawberries. A simple huller can be bought for five cents.

If practicable pare fruit with a silver knife, so as not to stain or darken the product. The quickest and easiest way to peel peaches is to drop them into boiling water for a few minutes. Have a deep kettle a little more than half full of boiling water; fill a wire basket with peaches, put a long-handled spoon under the handle of the basket and lower into the boiling water. At the end of three minutes lift the basket out by slipping the spoon under the handle. Plunge the basket for a moment into a pan of cold water. Let the peaches drain a minutes, then peel. Plums and tomatoes may be peeled in the same manner.

If the peaches are to be canned in syrup, put them at once into the sterilized jars. They may be canned whole or in halves. If in halves, remove nearly all the stones or pits. For the sake of the flavor, a few stones should be put in each jar.

When preparing cherries, plums or crabapples for canning or preserving, the stem or a part of it may be left on the fruit.

When preparing to make jelly have ready the cheesecloth strainer, enameled colander, wooden spoons, vegetable masher, tumblers, preserving kettles and sugar.

If currant jelly is to be made, free the fruit from leaves and large stems. If the jelly is to be made from any of the other small fruits, the stems and hulls must be removed.

When the jelly is to be made from any of the large fruits, the important part of the preparation is to have the fruit washed clean, then to remove the stem and the blossom end. Nearly all the large fruits are better for having the skin left on. Apples and pears needs not be cored. There is so much gummy substance in the cores of quinces that it is best not to use this portion in making fine jelly.

MAKING SYRUP FOR USE IN CANNING AND PRESERVING.

Such syrups are are used in canning and preserving are made with varying proportions of water and sugar. When the proportion of sugar is large and that of the water small the syrup is said to be heavy. When the water predominates the syrup is light.

There are several methods of measuring the proportion of sugar in a syrup. The most scientific and accurate is with the syrup gauge. Careful measurement or weighing is, however, quite satisfactory for all ordinary work if the syrup need not be boiled a long time. In boiling the water evaporates and the syrup grows thicker and richer. The amount of evaporation depends upon the surface exposed and the pressure of the atmosphere. For example, if a large quantity of syrup is boiled in a deep kettle the evaporation will not be rapid. If the same quantity of syrup were boiled the same length of time in a broad, shallow kettle the water would evaporate more rapidly and the syrup would be thicker and heavier. If a given quantity of syrup were boiled the same length of time in a high altitude, Colorado for example, and at the sea level, it would be found that the syrup boiled at the sea level would be thicker and less in volume than that boiled in Colorado. From this it will be seen that it is difficult to say what proportion of sugar a syrup will contain after it has been boiled ten or more minutes. Of course by the use of the syrup gauge the proportion of sugar in a syrup may be ascertained at any stage of the boiling. After all, however, it is possible to measure sugar and water so that you can know the percentage of sugar when the syrup begins to boil. The following statement gives the percentage of sugar at the time when the syrup has been boiling one minute and also what kind of syrup is suitable for the various kinds of fruit:

One pint sugar and 1 gill of water gives syrup of 40° density: use for preserved strawberries and cherries.

One pint sugar and one-half pint water gives syrup of 32° density.

One pint sugar and 3 gills water gives syrup of 28° density. Use either this or the preceding for preserved peaches, plums, quinces, currants, etc.

One pint sugar and 1 pint water gives syrup of 24° density: Use for canned acid fruits.

One pint sugar and 1½ pints water gives syrup of 17° density.

One pint sugar and 2 pints water gives syrup of 14° density: Use either of these two light syrups for canned pears, peaches, sweet plums, and cherries, raspberries, blueberries, and blackberries.

The lightest syrups may be used for filling up the jars after they are taken from the oven or boiler. The process of making a syrup is very simple, but there are a few points that must be observed if syrup and fruit are to be perfect. Put the sugar and water in the saucepan and stir on the stove until all the sugar is dissolved. Heat slowly to the boiling point and boil gently without stirring. The length of time that the syrup should boil will depend upon how rich it is to be. All syrups are better for boiling from ten to thirty minutes. If rich syrups are boiled hard, jarred, or stirred they are apt to crystallize. The syrup may be made a day or two in advance of canning time. The light syrups will not keep long unless sealed, but the heavy syrups keep well if covered well.

USE OF THE SYRUP GAUGE.

The syrup gauge is a graduated glass tube, with a weighted bulb, that registers from 0° to 50°, and that is employed to determine the quantity of sugar contained in a syrup.

If this gauge is placed in pure water the bulb will rest on the bottom of the cylinder or other container. If sugar be dissolved in the water the gauge will begin to float. The more sugar there is dissolved in the water the higher the gauge will rise. In making tests it is essential that the syrup should be deep enough to reach the zero point of the gauge. If a glass cylinder holding about half a gill is filled to about two-thirds its height, and the gauge is then placed in the cylinder, the quantity of sugar in the syrup will be registered on the gauge.

Experiments have demonstrated that when sugar is dissolved and heated in fruit juice, if the syrup gauge registers 25°, the proportion of sugar is exactly right for combining with the pectin bodies to make jelly. The syrup gauge and the glass cylinder must both be heated gradually that the hot syrup may not break them. If the gauge registers more than 25°, add a little more fruit juice. If, on the other hand, it registers less than 25°, add more sugar. In making syrups for canning and preserving fruits, the exact amount of sugar in a syrup may be ascertained at any stage of boiling, and the syrup be made heavier by adding sugar, or lighter by adding water, as the case demands.

CANNING FRUIT.

This method of preserving fruit for home use is from all points the most desirable. It is the easiest and commonly considered the most economical and the best, because the fruit is kept in a soft and juicy condition in which it is believed to be easily digested. The wise housekeeper will can her principal fruit supply, making only enough rich preserves to serve for variety and for special occasions.

The success of canning depends upon absolute sterilization. If the proper care is exercised there need be no failure, except in rare cases, when a spore has developed in the can. There are several methods of canning; and while the principle is the same in all methods, the conditions under which the housekeeper must do her work may, in her case, make one method more convenient than another. For this reason three will be given which are considered the best and easiest. These are: Cooking the fruit in the jars in an oven; cooking the fruit in the jars in boiling water; and stewing the fruit before it is put in the jars. The quantity of sugar may be increased if the fruit is liked sweet.

It is most important that the jars, covers, and rubber rings be in perfect condition. Examine each jar and cover to see that there is no defect in it. Use only fresh rubber rings, for if the rubber is not soft and elastic the sealing will not be perfect. Each year numbers of jars of fruit are lost because of the false economy in using an old ring that has lost its softness and elasticity. Having the jars, covers and rings in perfect condition, the next thing is to wash and sterilize them.

Have two pans partially filled with cold water. Put some jars in one, laying them on their sides, and some covers in the other. Place the pans on the stove where the water will heat to the boiling point. The water should boil at least ten or fifteen minutes. Have on the stove a shallow milk pan in which there is about 2 inches of boiling water. Sterilize the cups, spoons, and funnel, if you use one, by immersing in boiling water for a few minutes. When ready to put the prepared fruit in the jars slip a broad skimmer under a jar and lift it and drain free of water. Set the jar in the shallow milk pan and fill to overflowing with the boiling fruit. Slip a silver-plated knife or the handle of a spoon around the inside of the jar, that the fruit and juice may be

packed solidly. Wipe the rim of the jar, dip the rubber ring in boiling water and put it smoothly on the jar, then put on the cover and fasten. Place the jar on a board and out of a draft of cold air. The work of filling and sealing must be done rapidly, and the fruit must be boiling hot when it is put into the jars. If screw tops are use, it will be necessary to tighten them after the glass has cooled and contracted. When the fruit is cold wipe the jars with a wet cloth. Paste on the labels, if any, and put the jars on shelves in a cool, dark closet.

In canning, any proportion of sugar may be used, or fruit may be canned without the addition of any sugar. However, that which is designed to be served as a sauce should have the sugar cooked with it. Fruit intended for cooking purposes need not have the sugar added to it.

Juicy fruits, such as berries and cherries, require little or no water. Strawberries are better not to have water added to them. The only exception to this is when they are cooked in a heavy syrup.

RASPBERRIES

12 quarts of raspberries. 2 quarts of sugar.

Put 2 quarts of the fruit in the preserving kettle; heat slowly on the stove; crush with a wooden vegetable masher; spread a square of cheese cloth over a bowl, and turn the crushed berries and juice into it. Press out the juice, which turn into the preserving kettle. Add the sugar and put on the stove; stir until the sugar is dissolved. When the syrup begins to boil, add the remaining 10 quarts of berries. Let them heat slowly. Boil ten minutes, counting from the time they begin to bubble. Skim well while boiling. Put in cans and seal as directed.

RASPBERRIES AND CURRANTS.

10 quarts of raspberries. 2½ quarts of sugar.
3 quarts of currants.

Heat, crush, and press the juice from the currants and proceed as directed for raspberries.

BLACKBERRIES.

The same as for raspberries.

CURRANTS.

12 quarts of currants. 4 quarts of sugar.

Treat the same as for raspberries.

GOOSEBERRIES.

6 quarts of berries. 1 pint of water.
1½ quarts of sugar.

For green gooseberries dissolve the sugar in the water, then add the fruit and cook fifteen minutes. Ripe gooseberries are to be treated the same as the green fruit, but use only half as much water. Green gooseberries may also be canned the same as rhubarb.

BLUEBERRIES.

12 quarts of berries ½ pint of water.
1 quart of sugar.

Put water, berries, and sugar in the preserving kettle; heat slowly. Boil fifteen minutes, counting from the time the contents of the kettle begin o bubble.

CHERRIES.

6 quarts of cherries. ½ pint of water.
1½ quarts of sugar.

Measure the cherries after the stems have been removed. Stone them or not, as you please. If you stone them be careful to save all the juice. Put the sugar and water in the preserving kettle and stir over the fire until the sugar is dissolved. Put in the cherries and heat slowly to the boiling point. Boil ten minutes, skimming carefully.

GRAPES.

6 quarts of grapes. 1 gill of water.
1 quart of sugar.

Squeeze the pulp of the grapes out of the skins. Cook the pulp five minutes and then rub through a sieve that is fine enough to hold back the seeds. Put the water, skins, and pulp into the preserving kettle and heat slowly to the boiling point. Skim the fruit and then add the sugar. Boil fifteen minutes.

Sweet grapes may be canned with less sugar; very sour ones may have more.

RHUBARB.

Cut the rhubarb when it is young and tender. Wash it thoroughly and then pare; cut into pieces about 2 inches long. Pack in sterilized jars. Fill the jars to overflowing with cold water and let them stand ten minutes. Drain off the water and fill again to overflowing with fresh cold water. Seal with sterilized rings and covers. When required for use, treat the same as fresh rhubarb.

Green gooseberries may be canned in the same manner. Rhubard may be cooked and canned with sugar in the same manner as gooseberries.

PEACHES.

8 quarts of peaches. 3 quarts of water.
1 quart of sugar.

Put the sugar and water together and stir over the fire until the sugar is dissolved. When the syrup boils skim it. Draw the kettle back where the syrup will keep hot but not boil.

Pare the peaches, cut in halves, and remove the stones, unless you prefer to can the fruit whole.

Put a layer of the prepared fruit into the preserving kettle and cover with some of the hot syrup. When the fruit begins to boil, skim carefully. Boil gently for ten minutes, then put in the jars and seal. If the fruit is not fully ripe it may require a little longer time to cook. It is best to put only one layer of fruit in the preserving kettle. While this is cooking the fruit for the next batch may be pared.

PEARS.

If the fruit is ripe it may be treated exactly the same as peaches. If, on the other hand, it is rather hard it must be cooked until so tender that a silver fork will pierce it readily.

QUINCES.

4 quarts of pared, cored and quartered quinces. 1½ quarts of sugar. 2 quarts of water.

Rub the fruit hard with a coarse, crash towel, then wash and drain. Pare, quarter and core; drop the pieces into cold water. Put the fruit in the preserving kettle with cold water to cover it generously. Heat slowly and simmer gently until tender. The pieces will not all require the same time to cook. Take each piece up as soon as it is so tender that a silver fork will pierce it readily. Drain on a platter. Strain the water in which the fruit was cooked through cheese cloth. Put two quarts of the strained liquid and the sugar into the preserving kettle; stir over the fire until the sugar is dissolved. When it boils skim well and put in the cooked fruit. Boil gently for about twenty minutes.

CRABAPPLES.

6 quarts of apples. 2 quarts of water.
1½ quarts of sugar.

Put the sugar and water into the preserving kettle. Stir over the fire until the sugar is dissolved. When the syrup boils skim it.

Wash the fruit, rubbing the blossom end well. Put it in the boiling syrup, and cook gently until tender. It will take from twenty to fifty minutes, depending upon the kind of crap apple.

PLUMS.

8 quarts of plums. 1 pint of water.
2 quarts of sugar.

Nearly all kinds of plums can be cooked with the skins on. If it is desired to remove the skin of any variety, plunge them in boiling water for a few minutes. When the skins are left on, prick them thoroughly to prevent bursting.

Put the sugar and water into the preserving kettle and stir over the fire until the sugar is dissolved. Wash and drain the plums. Put some of the fruit in the boiling syrup. Do not crowd it. Cook five minutes; fill and seal the jars. Put more fruit in the syrup. Continue in this manner until all the fruit is done. It may be that there will not be sufficient syrup toward the latter part of the work; for

this reason it is well to have a little extra syrup on the back of the stove.

STEWED TOMATOES.

Wash the tomatoes and plunge into boiling water for five minutes. Pare and slice, and then put into the preserving kettle; set the kettle on an iron ring. Heat the tomatoes slowly, stirring frequently from the bottom. Boil for thirty minutes, counting from the time the vegetable begins actually to boil. Put in sterilized jars and seal.

WHOLE TOMATOES.

8 quarts of medium-sized tomatoes 4 quarts of sliced tomatoes.

Put the pared and sliced tomatoes into a stewpan and cook as directed for stewed tomatoes. When they have been boiling twenty minutes take from the fire and rub through a strainer. Return to the fire.

While the sliced tomatoes are cooking, pare the whole tomatoes and put them in sterilized jars. Pour into the jars enough of the stewed and strained tomato to fill all the interstices. Put the uncovered jars in a moderate oven, placing them on a pad of asbestos or in shallow pans of hot water. Let the vegetable cook in the oven for half an hour. Take from the oven and fill to overflowing with boiling hot, strained tomato, then seal. If there is any of the strained tomato left, can it for sauces.

CANNED FRUIT COOKED IN THE OVEN.

This method of canning fruit, in the opinion of the writer, is the one to be preferred. The work is easily and quickly done, and the fruit retains its shape, color, and flavor better than when cooked in the preserving kettle.

Cover the bottom of the oven with a sheet of asbestos, the kind plumbers employ in covering pipes. It is very cheap and may usually be found at plumbers' shops. If the asbestos is not available, put into the oven shallow pans in which there are about two inches of boiling water.

Sterilize the jars and utensils. Make the syrup; prepare the fruit the same as for cooking in the preserving kettle Fill the hot jars with it, and pour in enough syrup to fill the jar solidly. Run the blade of a silver-plated knife around the inside of the jar. Place the jars in the oven, either on the asbestos or in the pan of water. The oven should be moderately hot. Cook the fruit ten minutes; remove from the oven and fill the jar with boiling syrup. Wipe and seal. Place the jars on a board and out of a draft of air. If the screw covers are used tighten them after the glass has cooled.

Large fruits, such as peaches, pearls, quinces, crabapples, etc., will require about a pint of syrup to each quart jar of fruit. The small fruit will require a little over half a pint of syrup.

The amount of sugar in each quart of syrup should be regulated to suit the fruit with which it is to be used. The quantity of sugar may be increased or diminished to suit the taste.

CANNED FRUIT COOKED IN A WATER BATH.

Prepare the fruit and syrup as for cooking in the oven.

Fill the sterilized jars and put the covers on loosely. Have a wooden rack in the bottom of a wash boiler Put in enough warm water to come to about 4 inches above the rack. Place the filled jars in the boiler, but do not let them touch one another. Pack clean white cotton rags, or perhaps better, cotton rope, between and around the jars to prevent them from striking one another when the water begins to boil. Cover the boiler and let the fruit cook ten minutes from the time the water surrounding it begins to boil.

Draw the boiler back and take off the cover. When the steam passes off take out one jar at a time and place in a pan of boiling water beside the boiler, fill up with boiling syrup, and seal. Put the jars on a board and do not let cold air blow upon them. If screw tops are used tighten them when the glass has cooled and contracted.

PRESERVING FRUIT.

In the case of most fruits, canning with a little sugar is to be preferred to preserving with a large quantity of sugar. There are, however, some fruits that are only good when preserved with a good deal of sugar. Of course, such preparations of fruit are only desirable for occasional use. The fruits best adapted for preserving are straw-berries, sour cherries, sour plums and quinces. Such rich preparations should be put up in small jars or tumblers.

STRAWBERRIES.

Use equal weights of sugar and strawberries. Put the strawberries in the preserving kettle in layers, sprinkling sugar over each layer. The fruit and sugar should not be more than 4 inches deep. Place the kettle on the stove and heat the fruit and sugar slowly to the boiling point. When it begins to boil skim carefully. Boil ten minutes, counting from the time the fruit begins to bubble. Pour the cooked fruit into platters, having it about 2 or 3 inches deep. Place the platters in a sunny window, in an unused room, for three or four days. In that time the fruit will grow plump and firm, and the syrup will thicken almost to a jelly. Put this preserve, cold, into jars or tumblers.

WHITE CURRANTS.

Select large, firm fruit, remove the stems, and proceed as for strawberries.

CHERRIES.

The sour cherries, such as Early Richmond and Montmorency, are best for this preserve. Remove the stems and stones from the cherries and proceed as for strawberry preserve.

CHERRIES PRESERVED WITH CURRANT JUICE.

12 quarts of cherries. 2 quarts of sugar.
3 quarts of currants.

Put the currants in the preserving kettle and on the fire. When they boil up crush them and strain through cheese cloth, pressing out all the juice.

Stem and stone the cherries, being careful to save all the juice. Put the cherries, fruit juice, and sugar in the preserving kettle. Heat to the boiling point and skim carefully. Boil for twenty minutes. Put in sterilized jars or tumblers. This gives an acid preserve. The sugar may be doubled if richer preserves are desired.

PLUM PRESERVE.

4 quarts of green gages. 1 pint of water.
2 quarts of sugar.

Prick the fruit and put it in a preserving kettle. Cover generously with cold water. Heat to the boiling point and boil gently for five minutes. Drain well.

Put the sugar and water in a preserving kettle and stir over the fire until the sugar is dissolved. Boil five minutes, skimming well. Put the drained green gages in this syrup and cook gently for twenty minutes. Put in sterilized jars.

Other plums may be preserved in the same manner. The skins should be removed from white plums.

QUINCES

4 quarts of pared, quartered, and cored quinces. 2 quarts of sugar.
1 quart of water.

Boil the fruit in clear water until it is tender, then skim out and drain.

Put the 2 quarts of sugar and 1 quart of water in the preserving kettle; stir until the sugar is dissolved. Let it heat slowly to the boiling point. Skim well and boil for twenty minutes. Pour one-half of the syrup into a second kettle. Put one-half of the cooked and drained fruit into each kettle. Simmer gently for half an hour, then put in sterilized jars. The water in which the fruit was boiled can be used with the parings, cores, and gnarly fruit to make jelly.

FRUIT PUREES.

Purees of fruit are in the nature of marmalades, but they are not cooked so long, and so retain more of the natural flavor of the fruit. This is a particularly nice way to preserve the small, seedy fruits, which are to be used in puddings, cake, and frozen desserts.

Free the fruit from leaves, stems, and decayed portions. Peaches and plums should have the skins and stones removed. Rub the fruit through a puree sieve. To each quart of the strained fruit add a pint of sugar. Pack in sterilized jars. Put the covers loosely on the jars. Place the jars on the rack in the boiler. Pour in enough cold water to come half way up the sides of the jars. Heat gradually to the

boiling point and boil thirty minutes, counting from the time when the water begins to bubble.

Have some boiling syrup ready. As each jar is taken from the boiler put it in a pan of hot water and fill up with the hot syrup. Seal at once.

MARMALADES.

Marmalades require great care while cooking because no moisture is added to the fruit and sugar. If the marmalade is made from berries the fruit should be rubbed through a sieve to remove the seeds. If large fruit is used have it washed, pared, cored and quartered.

Measure the fruit and sugar, allowing one pint of sugar to each quart of fruit.

Rinse the preserving kettle with cold water that there may be a slight coat of moisture on the sides and bottom. Put alternate layers of fruit and sugar in the kettle, having the first layer fruit. Heat slowly, stirring frequently. While stirring, break up the fruit as much as possible. Cook about two hours, then put in small sterilized jars.

FRUIT PRESERVED IN GRAPE JUICE.

Any kind of fruit can be preserved by this method, but it is particularly good of apples, pears, and sweet plums. No sugar need be used in this process.

Boil 6 quarts of grape juice in an open preserving kettle, until it is reduced to 4 quarts. Have the fruit washed and pared, and, if apples or pears, quartered and cored. Put the prepared fruit in a preserving kettle and cover generously with the boiled grape juice. Boil gently until the fruit is clear and tender, then put in steriized jars.

BOILED CIDER.

When the apple crop is abundant and a large quantity of cider is made, the housekeeper will find it to her advantage to put up a generous supply of boiled cider. Such cider greatly improves mince-meat, and can be used at any time of the year to make cider apple sauce. It is also a good selling article.

The cider for boiling must be perfectly fresh and sweet. Put it in a large, open preserving kettle and boil until it is reduced one-half. Skim frequently while boiling. Do not have the kettle more than two-thirds full.

Put in bottles or stone jugs.

CIDER APPLE SAUCE.

5 quarts of boiled cider.	8 quarts of pared, quartered and cored sweet apples.

Put the fruit in a large preserving kettle and cover with the boiled cider. Cook slowly until the apples are clear and tender. To prevent burning, place the kettle on an iron tripod or ring. It will require from two to three hours to cook the apples. If you find it necessary to stir the sauce be careful to break the apples as little as possible. When the sauce is cooked, put in sterilized jars.

In the late spring, when cooking apples have lost much of their flavor and acidity, an appetizing sauce may be made by stewing them with diluted boiled cider, using 1 cupful of cider to 3 of water.

CIDER PEAR SAUCE.

Cooking pears may be preserved in boiled cider the same as sweet apples. If one prefers the sauce less sour, 1 pint of sugar may be added to each quart of boiled cider.

METHODS OF MAKING JELLY.

In no department of preserving does the housekeeper feel less sure of the result than in jelly making. The rule that works perfectly one time fails another time. Why this is so the average housekeeper does not know; so there is nearly always an element of uncertainty as to the result of the work. These two questions are being constantly asked: "Why does not my jelly harden?" "What causes my jelly to candy?"

It is an easy matter to say that there is something in the condition of the fruit, or that the fruit juice and sugar were cooked too short or too long a time. These explanations are often true; but they do not help the inquirer, since at other times just that proportion of sugar and time of cooking have given perfect jelly. In the following pages an attempt is made to give a clear explanation of the principles underlying the process of jelly making. It is believed that the women who study this carefully will find the key to unvarying success in this branch of preserving.

PECTIN, PECTOSE, PECTASE.

In all fruits, when ripe or nearly so, there is found pectin, a carbohydrate somewhat similar in its properties to starch. It is because of this substance in the fruit juice that we are able to make jelly. When equal quantities of sugar and fruit juice are combined and the mixture is heated to the boiling point for a short time, the pectin in the fruit gelatinizes the mass.

It is important that the jelly maker should understand when this gelatinizing agent is at its best. Pectose and pectase always exist in the unripe fruit. As the fruit ripens the pectase acts upon the pectose, which is insoluble in water, converting it into pectin, which is soluble. Pectin is at its best when the fruit is just ripe or a little before. If the juice ferments, or the cooking of the jelly is continued too long, the pectin undergoes a change and loses its power of gelatinizing. It is, therefore, of the greatest importance that the fruit should be fresh, just ripe or a little underripe, and that the boiling of the sugar and juice should not be continued too long.

Fruits vary as to the quantities of sugar, acid, pectin, and gums in their composition. Some of the sour fruits contain more sugar than do some of the milder-flavored fruits. Currants, for example, often contain four or five times as much sugar as the peach. The peach does not contain so much free acid and it does contain a great deal of pectin bodies, which mask the acid; hence, the comparative sweetness of the ripe fruit.

SELECTION AND HANDLING OF FRUIT FOR JELLY MAKING.

An acid fruit is the most suitable for jelly making, though in some of the acid fruits, the strawberry, for example, the quantity of the jelly-making pectin is so small that it is difficult to make jelly with this fruit. If, however, some currant juice is added to the strawberry juice, a pleasant jelly will be the result; yet, of course, the flavor of the strawberry will be modified. Here is a list of the most desirable fruits for jelly making. The very best are given first: Currant, crabapple, apple, quince, grape, blackberry, raspberry, peach.

Apples make a very mild jelly, and it may be flavored with fruits, flowers or spices. If the apples are acid it is not advisable to use any flavor.

Juicy fruits, such as currants, raspberries, etc., should not be gathered after a rain, for they will have absorbed so much water as to make it difficult, without excessive boiling, to get the juice to jelly.

If berries are sandy or dusty it will be necessary to wash them, but the work should be done very quickly so that the fruit may not absorb much water.

Large fruits, such as apples, peaches, and pears, must be boiled in water until soft. The strained liquid will contain the flavoring matter and pectin.

It requires more work and skill to make jellies from the fruits to which water must be added than from the juicy fruits. If the juicy fruits are gathered at the proper time one may be nearly sure that they contain the right proportion of water. If gathered after a rain the fruit must be boiled a little longer that the superfluous water may pass off in steam.

In the case of the large fruits a fair estimate is 3 quarts of strained juice from 8 quarts of fruit and about 4 quarts of water. If the quantity of juice is greater than this it should be boiled down to 3 quarts.

Apples will always require 4 quarts of water to 8 quarts of fruit, but juicy peaches and plums will require only 3 to 3½ quarts.

The jelly will be clearer and finer if the fruit is simmered gently and not stirred during the cooking.

It is always best to strain the juice first through cheese cloth and without pressure. If the cloth is double the juice will be quite clear. When a very clear jelly is desired the strained juice should pass through a flannel or felt bag. The juice may be pressed from the fruit left in the strainer and used in marmalade or for a second-quality jelly.

To make jelly that will not crystallize (candy) the right proportion of sugar must be added to the fruit juice. If the fruit contains a high percentage of sugar, the quantity of added sugar should be a little less than the quantity of fruit juice. That is to say, in a season when there has been a great deal of heat and sunshine there will be more sugar in the fruit than in a cold, wet season; consequently, 1 pint of currant juice will require but three-quarters of a pint of sugar. But in a cold, wet season the pint of sugar for the pint of juice must be measured generously.

Another cause of the jelly crystallizing is hard boiling. When the syrup boils so rapidly that particles of it are thrown on the upper part of the sides of the preserving kettle they often form crystals. If these crystals are stirred into the syrup they are apt to cause the mass to crystallize in time.

The use of the syrup gauge and care not to boil the syrup too violently would do away with all uncertainty in jelly making. The syrup gauge should register 25°, no matter what kind of fruit is used.

Jellies should be covered closely and kept in a cool, dark place.

CURRANT JELLY.

The simplest method of making currant jelly is perhaps the following: Free the currants from leaves and large stems. Put them in the preserving kettle; crush a few with a wooden vegetable masher or spoon; heat slowly, stirring frequently.

When the currants are hot, crush them with the vegetable masher. Put a hair sieve or strainer over a large bowl; over this spread a double square of cheese cloth. Turn the crushed fruit and juice into the cheese cloth, and let it drain as long as it drips, but do not use pressure. To hasten the process take the corners of the straining cloth firmly in the hands and lift from the sieve; move the contents by raising one side of the cloth and then the other. After this put the cloth over another bowl. Twist the ends together and press out as much juice as possible. This juice may be used to make a second quality of jelly.

The clear juice may be made into jelly at once, or it may be strained through a flannel bag. In any case, the method of making the jelly is the same.

Measure the juice, and put it in a clean preserving kettle. For every pint of juice add a pint of granulated sugar.

Stir until the sugar is dissolved, then place over the fire; watch closely, and when it boils up draw it back and skim; put over the fire again, and boil and skim once more; boil and skim a third time; then pour into hot glasses taken from the pan of water on the stove and set on a board. Place the board near a sunny window in a room where there is no dust. It is a great protection and advantage to have sheets of glass to lay on top of the tumblers. As soon as the jelly is set cover by one of the three methods given.

To make a very transparent jelly, heat, crush, and strain the currants as directed in the simplest process. Put the strained juice in the flannel bag and let it drain through. Measure the juice and sugar, pint for pint, and finish as directed above.

To make currant jelly by the cold process follow the first rule for jelly as far as dissolving the sugar in the strained juice. Fill warm, sterilized glasses with this. Place the glasses on a board and put the board by a sunny window. Cover with sheets of glass and keep by the window until the jelly is set. The jelly will be more transparent if the juice is strained through the flannel bag. Jelly made by the cold process is more delicate than that made by boiling, but it does not keep quite so well.

RASPBERRY AND CURRANT JELLY.

Make the same as currant jelly, using half currants and half raspberries.

RASPBERRY JELLY.

Make the same as currant jelly.

BLACKBERRY JELLY.

Make the same as currant jelly.

STRAWBERRY JELLY.

To 10 quarts of strawberries add 2 quarts of currants and proceed as for currant jelly, but boil fifteen minutes.

RIPE-GRAPE JELLY.

An acid grape is best for this jelly. The sweet, ripe grapes contain too much sugar. Half-ripe fruit, or equal portions of nearly ripe and green grapes, will also be found satisfactory. Wild grapes make delicious jelly. Make the same as currant jelly.

GREEN-GRAPE JELLY.

Make the same as apple jelly.

PLUM JELLY.

Use an underripe acid plum. Wash the fruit and remove the stems. Put into the preserving kettle with 1 quart of water for each peck of fruit. Cook gently until the plums are boiled to pieces. Strain the juice and proceed the same as for currant jelly.

APPLE JELLY.

Wash, stem, and wipe the apples, being careful to clean the blossom end thoroughly. Cut into quarters and put into the preserving kettle. Barely cover with cold water (about 4 quarts of water to 8 of apples) and cook gently until the apples are soft and clear. Strain the juice and proceed as for currant jelly. There should be but 3 quarts of juice from 8 quarts of apples and 4 of water.

Apples vary in the percentage of sugar and acid they contain. A fine-flavored acid apple should be employed when possible. Apple jelly may be made at any time of the year, but winter apples are best and should be used when in their prime, i. e., from the fall to December or January. When it is found necessary to make apple jelly in spring, add the juice of one lemon to every pint of apple juice.

CIDER APPLE JELLY.

Make the same as plain apple jelly, but covering the apples with cider instead of water. The cider must be fresh from the press.

CRABAPPLE JELLY.

Make the same as plain apple jelly.

QUINCE JELLY.

Rub the quinces with a coarse crash towel; cut out the blossom end. Wash the fruit and pare it and cut in quarters. Cut out the cores, putting them in a dish by themselves. Have a large bowl half full of water; drop the perfect pieces of fruit into this bowl. Put the parings and imperfect parts, cut very fine, into the preserving kettle. Add a quart of water to every 2 quarts of fruit and parings. Put on the fire and cook gently for two hours. Strain and finish the same as apple jelly. The perfect fruit may be preserved or canned.

To make quince jelly of a second quality, when the parings and fruit are put on to cook put the cores into another kettle and cover them generously with water and cook two hours. After all the juice has been drained from the parings and fruit, put what remains into the preserving kettle with the cores. Mix well and turn into the straining cloth. Press all the juice possible from this mixture. Put the juice in the preserving kettle with a pint of sugar to a pint of juice; boil ten minutes.

WILD FRUITS FOR JELLIES.

Wild raspberries, blackberries, barberries, grapes, and beach plums all make delicious jellies. The frequent failures in making barberry jelly come from the fruit not being fresh or from being overripe.

PREPARATION OF THE GLASSES FOR JELLY.

Sterilize the glasses; take from the boiling water and set them in a shallow baking pan in which there is about 2 inches of boiling water.

COVERING JELLIES.

Jellies are so rich in sugar that they are protected from bacteria and yeasts, but they must be covered carefully to protect them from mold spores and evaporation. The following methods of covering jellies are all good:

Have disks of thick white paper the size of the top of the glass. When the jelly is set, brush the top over with brandy or alcohol. Dip a disk of paper in the spirits and put it on the jelly. If the glasses have covers, put them on. If there are no covers, cut disks of paper about half an inch in diameter larger than the top of the glass. Beat together the white of one egg and a tablespoonful of cold water. Wet the paper covers with this mixture and put over the glass, pressing down the sides well to make them stick to the glass; or the covers may be dipped in olive oil and be tied on the glasses, but they must be cut a little larger than when the white of egg is used.

A thick coating of paraffin makes a good cover, but not quite so safe as the paper dipped in brandy or alcohol, because the spirits destroy any mold spores that may happen to rest in the jelly. If such spores are covered with the paraffin they may develop under it.

However, the paper wet with spirits could be put on first and the paraffin poured over it.

If paraffin is used, break it into pieces and put in a cup. Set the cup in a pan of warm water on the back of the stove. In a few moments it will be melted enough to cover the jelly. Have the coating about a fourth of an inch thick. In cooling the paraffin contracts, and if the layer is very thin it will crack and leave a portion of the jelly exposed.

CANNED OR BOTTLED FRUIT JUICES.

Fruit juice is most desirable for drinking or for culinary purposes. Grape juice is particularly good as a drink. It may be canned with or without sugar but, except where the grapes have a large percentage of sugar, as is the case in California, some sugar should be added to the juice in canning.

Currant juice may be sterilized and canned without sugar. This juice may be made into jelly at any season of the year.

Fruit juices that are designed for use in frozen creams and water ices should be canned with a generous amount of sugar.

For grape juice good bottles are to be preferred to fruit cans. If you can get the self-sealing bottles, such as pop or beer comes in, the work of putting up grape juice will be light. If bottles are employed, be very careful to sterilize both bottles and corks.

GRAPE JUICE.

Wash the grapes and pick from the stems. Put the fruit in the preserving kettle and crush slightly. Heat slowly and boil gently for half an hour. Crush the fruit with a wooden spoon.

Put a sieve or colander over a large bowl and spread a square of cheese cloth over the sieve. Turn the fruit and juice into the cheese cloth; drain well, then draw the edges of the cheese cloth together and twist hard to press out all the juice possible.

Put the strained juice in a clean preserving kettle and on the fire. When it boils up, draw back and skim. Let it boil up again and skim; then add the sugar and stir until dissolved. Boil five minutes, skimming carefully. Fill hot sterilized jars or bottles. Put the jars or bottles in a moderate oven for ten minutes, in pans of boiling water. Have some boiling juice and pour a litle of it into the jars as they are taken from the oven; then seal. Place on boards and set aside out of a cold draft.

A good proportion of sugar and juice is 1 gill of sugar to a quart of juice. The preparation and use of grape juice has been discussed at length in an earlier bulletin of this series.*

RASPBERRY, BLACKBERRY, STRAWBERRY, AND CURRANT JUICES.

With all these fruits except currants, proceed the same as for grape juice, but adding half a pint of sugar to each quart of juice. Currants will require 1 pint of sugar to a quart of juice.

CHERRY, PLUM, AND PEACH JUICES.

To preserve the juice of cherries, plums, peaches, and similar fruits, proceed as for jelly, but adding to each quart of juice half a pint of sugar instead of a quart as for jelly. If it is not desired to have the fruit juice transparent, the pulp of the fruit may be pressed to extract all the liquid.

FRUIT SYRUPS.

The only difference between syrups and juice is that in the syrup there must be at least half as much sugar as fruit juice.

These syrups are used for flavoring ice creams and water ices. They also make a delicious drink, when two or three spoonfuls are added to a glass of ice water.

RASPBERRY VINEGAR.

Put 4 quarts of raspberries in a bowl and pour over them 2 quarts of vinegar. Cover and set in a cool place for two days. On the second day strain the vinegar through cheese cloth. Put 4 quarts of fresh raspberries in the bowl and pour over them the vinegar strained from the first raspberries. Put in a cool place for two days, then strain. Put the strained juice in a preserving kettle with 3 quarts of sugar. Heat slowly, and when the vinegar boils skim carefully. Boil twenty minutes, then put in sterilized bottles.

About 2 tablespoonfuls of vinegar to a glass of water makes a refreshing drink.

Similar vinegars may be made from blackberries and strawberries.

*U. S. Dept. Agr., Farmers' Bulletin No. 175.

Recipes for Huyler's Famous Cocoa and Chocolate

If You Want the Best Cup of Cocoa—Use Huyler's.

For each breakfast cup take one teaspoonful of Huyler's Cocoa; mix this with boiling water or milk, **adding the latter gradually and stirring thoroughly to form a smooth paste**; to this paste more water or milk is then added until the desired richness is obtained; then let it boil at least one minute (as boiling improves it). Add sugar at the table to suit the taste.

If You Want the Best Chocolate—Use Huyler's.

(Recipes taken by permission from The Century Cook Book)

How to Melt Chocolate.

Break the chocolate into pieces and put them into a dry pan on the stove where the heat is moderate. The chocolate melts quickly and must be carefully watched or it will burn. Add a few spoonfuls of milk to melted chocolate to dissolve it before adding it to custards.

Chocolate Sauce.

Put a half cupful each of sugar and water in a saucepan and let boil five minutes. Let the syrup cool, then stir it slowly into four ounces (squares) of Huyler's Baking (Blue Wrapper) Chocolate melted; add one-half teaspoonful of vanilla. Let it stand in a pan of hot water until ready to serve; then add one-half cupful of cream or milk. This sauce should be smooth and of the consistency of heavy cream. If it is to be used as a sauce for ice cream, omit the cream or milk, and make it of the right consistency with water instead.

Chocolate Filling.

Melt four ounces (squares) of Huyler's Baking (Blue Wrapper) Chocolate. Dilute it with three tablespoonfuls of milk and then add a cupful of sugar mixed with a well beaten egg; stir until thickened.

Chocolate Icing.

Melt in a dry pan four ounces (squares) of Huyler's Baking (Blue Wrapper) Chocolate, or the same quantity of Huyler's Cocoa. Boil one and three-quarter cupfuls of sugar with a cupful of water until it "threads" when dropped from the spoon. Turn it slowly upon the melted chocolate, stirring all the time. Use this icing for dipping eclairs and small cakes and for layer cakes.

Chocolate Ice Cream.

Beat three whole eggs and one cupful of sugar together; stir one quart of scalded milk into them slowly; replace on fire in a double boiler and stir constantly until the custard coats the spoon. **Do not let it boil or it will curdle.** Melt four ounces (squares) of Huyler's Baking (Blue Wrapper) Chocolate, and dilute it with a very little milk or custard to make it smooth, then adding it to the custard **while the latter is hot.** Beat the custard a little while after taking it off the stove; when it is cold add one tablespoonful of vanilla and freeze. Cream (even a few spoonfuls) will improve this mixture. More eggs also will give richer ice cream.

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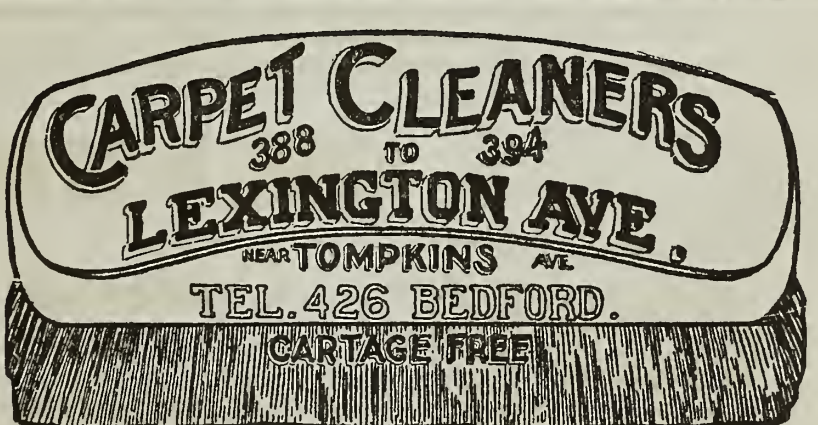

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